

Evaluation, Measurement, and Verification Report for the 2011 Roseville Electric Commercial Lighting Energy Efficiency Program

Prepared for Roseville Electric

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1. Executive Summary

This report provides the Evaluation, Measurement, and Verification (EM&V) findings for the 2011 Roseville Electric commercial lighting energy efficiency programs. This study was conducted by Robert Mowris & Associates (RMA) with public benefits funds under the auspices of the Northern California Power Agency (NCPA) and the California Energy Commission. Roseville implemented commercial lighting projects at 14 sites in 2011 as shown in **Table 1.1**. The programs provided educational information and incentives to commercial customers. The program ex ante goal was to install 25,743 energy lighting efficiency measures and Roseville accomplished 27,629 installed measures and this is 7.3% greater than the ex ante goal.

Table 1.1 Ex Ante Goals and Ex Post Accomplishments

Site	Ex Ante Goal	Ex Post Accomplishment
1	1,822	1,822
2	1,108	1,109
3	28	28
4	878	878
5	540	540
6	10,447	11,629
7	2,306	2,314
8	61	61
9	1,225	1,226
10	2,251	2,251
11	134	428
12	2,379	2,379
13	2,544	2,544
14	20	420
Total	25,743	27,629

Roseville Electric achieved 55% greater lifecycle electricity savings with ex post savings of 36,371,167 kWh versus ex ante goal of 23,468,661 kWh. Roseville exceeded the ex ante E3 Calculator Total Resource Cost (TRC) test goal by 66% with an ex post TRC of 2.98 and the ex ante TRC of 1.80 as shown in **Table 1.2**.¹ The ex post TRC is greater than the ex ante TRC due to greater savings per measure due to field measurements of pre and post retrofit installations and operational hours.. Ex post accomplishments were verified by checking the tracking database, randomly inspecting 26,580 measures at 10 participant sites, installing 22 light loggers, and conducting surveys of participants, non-participants, and non-contacts. The EM&V ex post savings are based on site inspections, light logger data, and engineering analysis including light logger data from 454 fixtures and pre and post-retrofit utility billing data.

¹ Energy and Environmental Economics (E3), Inc. 2011. EE Reporting Tool 2011 (E3 Calculator). Prepared for the Northern California Power Agency (NCPA) and Southern California Public Power Authority (SCPPA), 353 Sacramento Street, Suite 1700, San Francisco, CA 94111.

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Table 1.2 Ex Ante Goals and Ex Post E3 Cost Effectiveness

Description	Ex Ante Goal	Ex Post Accomplishment
Net Annual Electricity Savings (kWh/yr)	2,133,515	3,306,470
Net Demand Savings (kW)	430	552.7
Net Lifecycle Electricity Savings (kWh)	23,468,661	36,371,167
Total Resource Cost (TRC) Test – E3	1.80	2.98
TRC Test Costs	\$1,254,693	\$1,211,260
TRC Test Benefits	\$2,266,027	\$3,503,335
TRC Test Net Benefits	\$1,011,334	\$2,292,075
Participant Test	0.34	0.34
Participant Test Costs	\$401,245	\$401,245
Participant Test Benefits	\$1,173,806	\$1,173,806
Participant Test Net Benefits	\$(772,561)	\$(772,561)

The ex ante first-year savings are summarized in **Table 1.3**. The first-year net ex ante program savings are 2,133,515 kWh and 429.7 kW, and the lifecycle savings are 23,468,661 kWh. Lifecycle savings assume the effective useful lifetime (EUL) is 11 years based on the Database for Energy Efficient Resources (DEER) EUL Summary.²

Table 1.3 Ex Ante First-Year and Lifecycle Electricity Savings

Site	Ex Ante Program Quantity	Gross Ex Ante Program Savings (kW)	Gross Ex Ante Program Savings (kWh/y)	Net-to-Gross Ratio	Net Ex Ante Program Savings (kW)	Net Ex Ante Program Savings (kWh/y)	Net Ex Ante Lifecycle Savings (kWh)
1	1,822	23.83	121,802	0.85	20.25	103,532	1,138,849
2	1,108	171.11	856,405	0.85	145.44	727,944	8,007,387
3	28	1.10	9,519	0.85	0.93	8,091	89,005
4	878	5.53	47,218	0.85	4.70	40,135	441,488
5	540	4.50	38,959	0.85	3.83	33,115	364,270
6	10,447	78.03	282,569	0.85	66.32	240,184	2,642,020
7	2,306	17.34	62,639	0.85	14.74	53,243	585,675
8	61	1.08	9,355	0.85	0.92	7,951	87,466
9	1,225	79.60	658,130	0.85	67.66	559,411	6,153,516
10	2,251	52.60	170,576	0.85	44.71	144,990	1,594,886
11	134	7.32	32,475	0.85	6.23	27,604	303,641
12	2,379	21.64	76,239	0.85	18.39	64,803	712,835
13	2,544	41.08	140,911	0.85	34.92	119,774	1,317,518
14	20	0.80	3,220	0.85	0.68	2,737	30,107
Total	25,743	505.6	2,510,017	0.85	429.7	2,133,515	23,468,661

The EM&V ex post first-year savings are summarized in **Table 1.4**. The EM&V study found first-year net ex post program savings of 3,306,470 ± 94,372 kWh per year, 552.7 ± 15 kW, and lifecycle net ex post program savings of 36,371,167 ± 1,038,092 kWh. Lifecycle savings assume the EUL is 11 years based on DEER.³ The realization rates are 1.55 ± 0.04 for kWh and for 1.29 ± 0.03 kW.

² Available online: http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls.

³ Ibid.

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Table 1.4 Ex Post First-Year and Lifecycle Electricity Savings

Site	Ex Post Program Quantity	Gross Ex Post Program Savings (kW)	Gross Ex Post Program Savings (kWh/y)	Net-to-Gross Ratio	Net Ex Post Program Savings (kW)	Net Ex Post Program Savings (kWh/y)	Net Ex Post Lifecycle Savings (kWh)
1	1,822	22.56	118,654	0.22	5.01	26,368	290,044
2	1,109	211.18	1,331,714	0.75	158.39	998,785	10,986,638
3	28	4.29	15,330	0.89	3.81	13,627	149,896
4	878	22.85	49,948	0.89	20.31	44,399	488,385
5	540	17.73	40,400	0.89	15.76	35,911	395,019
6	11,629	122.68	703,985	0.88	107.69	617,942	6,797,367
7	2,314	25.52	45,342	0.97	24.81	44,082	484,907
8	61	3.92	7,590	0.91	3.57	6,905	75,951
9	1,226	78.90	654,412	0.99	78.02	647,140	7,118,544
10	2,251	54.66	376,889	0.94	51.62	355,950	3,915,454
11	428	44.03	310,727	0.97	42.81	302,096	3,323,056
12	2,379	39.69	219,523	0.74	29.55	163,423	1,797,648
13	2,544	40.54	180,390	0.22	9.01	40,087	440,952
14	420	3.05	12,505	0.78	2.38	9,755	107,306
Total	27,629	691.6	4,067,408	0.81	552.7	3,306,470	36,371,167

The required energy impact reporting for 2011 programs is provided in **Table 1.5**.

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Table 1.5 Required Energy and Water Impact Reporting for 2011 Program

Program ID:		Roseville Electric Commercial Lighting Energy Efficiency Programs							
Program Name:		All							
Year	Year	Ex-ante Gross Program-Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)	Ex-Ante Gross Program-Projected Program Water CCF Savings (1)	Ex-Post Net Evaluation Confirmed Program Water CCF Savings (2)
1	2012	2,510	3,306	0.51	0.55				
2	2013	2,510	3,306	0.51	0.55				
3	2014	2,510	3,306	0.51	0.55				
4	2015	2,510	3,306	0.51	0.55				
5	2016	2,510	3,306	0.51	0.55				
6	2017	2,510	3,306	0.51	0.55				
7	2018	2,510	3,306	0.51	0.55				
8	2019	2,510	3,306	0.51	0.55				
9	2020	2,510	3,306	0.51	0.55				
10	2021	2,510	3,306	0.51	0.55				
11	2022	2,510	3,306	0.51	0.55				
12	2023								
13	2024								
14	2025								
15	2026								
16	2027								
17	2028								
18	2029								
19	2030								
20	2031								
Total		27,610	36,283						

** Peak MW savings are defined in this evaluation as the weekday peak period Monday through Friday from 2PM to 6PM during the months of May through September.

1. Gross Program-Projected savings are those savings projected by the program before NTG adjustments. 1 CCF = 748 gallons.
2. Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

The Roseville Electric energy efficiency portfolio utility cost is \$0.04/kWh and the net lifecycle green house gas (GHG) reductions are 20,156 tons. Roseville programs realized a 2.98 TRC which is 66% greater than anticipated due to installing 7.3% more measures and greater savings per site based on pre-existing fixture Wattage versus installed energy efficient fixture Wattage and light logger data regarding hours of operation.

Participant and non-participant process surveys were used to obtain general feedback and suggestions. Survey results indicate 100 percent of participants are satisfied with the program based on 350 survey responses to 35 questions from 10 participants. Most participants expressed appreciation for information and incentives. Process survey responses indicated significant demand for the program with an overall rating of 10 out of 10 points. Participants indicated that they were "very happy with the program and the energy efficient lighting." Process survey results, on-site verification inspections, and field measurements were used to guide the overall process evaluation in terms of investigating operational characteristics of the program and developing specific recommendations to help make the program more cost effective, efficient, and operationally effective. The following process evaluation recommendations are provided to improve program services, procedures, and cost effectiveness.

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- The overall net-to-gross ratio (NTGR) was 0.81 based on conducting decision maker surveys with 10 participants. This indicates that 19 percent of customers are free riders who might have installed energy efficient lighting without the incentives. However, this also indicates the effectiveness of Roseville Electric energy efficient lighting programs in transforming the market for energy efficient commercial lighting.
- Roseville Electric is in the process of implementing an internet rebate tracking and reporting system with crmOrbit, inc. (Energy Orbit). This system allows customers and contractors to submit rebate applications for energy efficiency and renewable energy programs. The system will track paid and reserved rebate applications, incentives paid, and energy and peak demand savings associated with the rebate including supporting documentation required for EM&V purposes. Roseville Electric staff will be able to process rebates in a secure, paperless environment.
- Based on findings from this study, many large commercial customers (81%) do not have sufficient capital or motivation to invest in improving the energy efficiency of their lighting systems without incentives from Roseville Electric. To overcome these market barriers, Roseville Electric energy efficiency programs should be continued and expanded to save energy and peak demand and reduce carbon dioxide emissions.

A discussion of actionable recommendations for program changes that can be expected to improve the cost effectiveness of the program, improve overall or specific operations, or improve satisfaction or, of course, all three are provided in the process evaluation section (see section **4.4.2 Process Evaluation Recommendations**).

Section 2 describes the CEC EM&V checklist information. **Section 3** describes the EM&V objectives, including baseline information, energy efficiency measure information, measurement and verification approach, and the evaluation approach. **Section 3** also includes equations used to develop energy and peak demand savings, sample design, methods used to verify proper installation of measures, and methods used to perform field measurements. **Section 4** provides EM&V study findings including load impact results and process evaluation results regarding what works, what doesn't work, and recommendations to improve the program's services and procedures. **Section 4** also includes measure recommendations to increase savings, achieve greater persistence, and improve customer satisfaction. **Appendix A** provides the CEC EM&V Checklist. **Appendix B** provides the participant decision-maker survey instrument for the Roseville Electric programs. **Appendix C** provides the Light Logger Metering Equipment Protocols. **Appendix D** provides the Lighting Rebate Site EM&V Reports.

2. CEC EM&V Checklist Information

This section provides information required in the CEC EM&V checklist (Appendix A).

2.1 Contextual Reporting

- Clearly state savings values and compare to the associated SB 1037 annual report.

Table 2.1 provides a comparison of the EM&V savings values compared to the associated SB 1037 annual report.⁴ The EM&V study found net peak demand savings of 552.7 ± 15 kW, net annual savings of $3,306,470 \pm 94,732$ kWh per year, net lifecycle savings of $36,371,167 \pm 1,038,092$ kWh, and net lifecycle green house gas savings of $20,156 \pm 575$ tons. With respect to the SB 1037 annual report for Roseville Electric, the EM&V study savings represent 28% of peak kW, 38% of annual kWh, and 29% of lifecycle kWh and GHG savings.

- What portion of the portfolio is covered? Describe the programs or savings not evaluated?

The EM&V study evaluated the large commercial lighting program which represents 23% of the total budget and 29% of the total lifecycle savings (see **Table 2.1**). The study did not evaluate residential or small commercial programs which represent 57% of the total budget and 71% of the total lifecycle savings.

- Assess risk or uncertainly in selecting the components of the portfolio to evaluate.

The uncertainties associated with selecting the components of the portfolio to evaluate are unknown. The uncertainties associated with the EM&V study of the commercial lighting program are 3% of the net savings at the 90 percent confidence level.

Table 2.1 EM&V Savings Compared to SB 1037 Annual Report

Description	SB 1037	EM&V Study	%
Net Peak kW Savings	2,001	553	28%
Net Annual kWh Savings	8,633,947	3,306,470	38%
Net Lifecycle kWh Savings	126,157,001	36,371,167	29%
Net Lifecycle GHG Savings (tons)	68,474	20,156	29%
Utility Incentive Cost (\$)	\$930,218	\$401,245	43%
Utility Marketing, EM&V, and Administrative Cost (\$)	\$1,702,986	\$196,772	12%
Total Utility Cost (\$)	\$2,633,204	\$598,017	23%
TRC	4.3	3.0	69%

⁴ Energy Efficiency in California's Public Power Sector: A Status Report, March 2012, prepared by the California Municipal Utilities Association (CMUA), Scott Tomashefsky, Northern California Power Agency (NCPA), Julie Felipe, Southern California Public Power Authority (SCPPA), Tony Andreoni, CMUA.

2.2 Overview and Documentation of Evaluation Effort

- Clearly identify what is being evaluated in the study (part of a program; an entire program; the entire portfolio).

The EM&V study evaluated the commercial lighting program which provided incentives of \$401,245 to 12 customers who installed measures at 14 sites. The EM&V study performed on-site inspections to verify the measures and installed 22 light loggers to measure hours of operation. The study also conducted surveys with decision maker at each site to evaluate net-to-gross ratios (i.e., free riders) and customer satisfaction and obtain customer feedback and suggestions to improve the program (see **Appendix B**).

- Include an assessment of EUL and lifecycle savings.

The EM&V lifecycle savings are based on an effective useful lifetime (EUL) of 11 years based on the DEER.⁵ The EM&V study did not have sufficient time or budget to assess the EUL for the commercial lighting program measures. The EM&V study found the following gross lifecycle savings of 44,741,492 kWh and 24,795 tons of greenhouse gas (GHG) emissions. The ex ante gross lifecycle savings of 27,610,189 kWh and 15,301 tons of GHG emissions.

- Provide documentation of all engineering and billing analysis algorithms, assumptions, survey instruments and explanation of methods.

Documentation of all engineering algorithms, assumptions, survey instruments, and methods are provided in **Section 2**.

- Describe the methodology in sufficient detail that another evaluator could replicate the study and achieve similar results.

The methodology is described in **Section 2**.

- Include all data collection instruments in an appendix.

Data collection instruments are provided in **Appendix B**.

- Describe metering equipment and protocols in an appendix.

Light logger metering equipment and protocols are provided in **Appendix C**.

2.3 Gross Savings

- Review the program's choice of baseline.

The program implementer used the E3 calculator to develop the baseline savings estimates.⁶

⁵ Ibid.

⁶ Energy and Environmental Economics (E3), Inc. 2011. EE Reporting Tool 2011 (E3 Calculator). Prepared for the Northern California Power Agency (NCPA) and Southern California Public Power Authority (SCPPA), 353 Sacramento Street, Suite 1700, San Francisco, CA 94111.

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- Characterize the population of participants.

The population of participants includes 12 large commercial customers with average floor area of 122,800 +/- 80,843 square feet of conditioned floor area. The building types include large retail, medium/large office, high technology manufacturing, telephone, scientific, elementary schools, high schools, and hospital.

- Discuss the sampling approach and sample design.

The sample selection includes 10 of the largest sites representing 99% of the total ex ante savings for 12 total participants.

- State the sampling precision targets and achieved precision.

The sampling precision targets are +/- 10%. The EM& study achieved +/-3% precision at the 90% +/- 10% confidence level based on average savings per measure and 27,585 measures. The uncertainty associated with the savings is +/-19.3% based on the uncertainty associated with the EUL of 12.5 +/- 2.4 years based on the mean time before failure (MTBF) of 50,000 hours for electronic ballasts and lighting operation of 4,163 +/- 803 hours per year based on light logger data.

- Present ex post gross savings.

The EM&V study found the following gross savings for the program 691.6 kW, 4,067,408 kWh per year and lifecycle savings of 44,741,492 kWh and 24,795 tons of greenhouse gas (GHG) emissions.

- Expand the results to the program population. If not, state why not; and clearly indicate where ex ante savings are being passed through.

The EM&V commercial lighting results cannot be expanded to the total portfolio savings since the residential or small commercial programs are not included in this evaluation and these programs are different than commercial lighting programs in terms of implementation, end use technologies, energy efficiency measures, and operational characteristics. The following residential and small commercial net ex ante savings are being passed through: 1,451 kW, 5,335,480 kWh first year savings, 89,873,868 lifecycle kWh, and 48,366 lifecycle tons of GHG emissions.

- Explain any differences between ex ante and ex post savings.

The ex ante gross savings for the large commercial lighting program are 505.6 kW, 2,510,017 kWh per year and lifecycle savings of 27,610,189 kWh and 15,301 tons of GHG emissions. Roseville programs achieved 62% greater gross ex post savings than the ex ante savings for the following reasons: 1) 7.3% more measures were installed, and 2) the EM&V study found greater savings per measure (ex ante savings are based on deemed savings from E3). The ex post savings are based on accurate measurements of lighting hours of operation (based on light logger data) and verification of pre and post fixture Wattages.

2.4 Net Savings

- Include a quantitative assessment of net-to-gross. If not, clearly indicate the source of the assumed net-to-gross value.

The quantitative assessment of the net-to-gross ratio (NTGR) is provided in **Section 3**. The weighted average NTGR is 0.81 based on surveys of 10 out of 12 decision makers who participated in for the large commercial lighting program.

- Discuss the sampling approach and sample design.

The EM&V study sample approach and sample design are based on a virtual census. The sample included on-site visits at 10 sites and surveys conducted with 10 out of 12 decision makers. This sample represents 98% of the ex ante savings for the large commercial lighting program.

- If a self-report method is used, does the approach account for free-ridership?

The EM&V study used a self-report method including interviews with participants. Non participant surveys were not conducted due to time and budget limitations. The survey results indicate 19% of participants are free riders who indicated that they would have installed energy efficient lighting measures without the rebates. The gross savings are reduced by 19% to account for free-ridership.

2.5 EM&V Summary and Conclusions

- Provide clear recommendations for improving program processes to achieve measurable and cost-effective energy savings.

Many large commercial customers (i.e., 81%) said they would not have installed energy efficient lighting without incentives from Roseville Electric. These customers did not have sufficient capital or motivation to invest in improving the energy efficiency of their lighting systems without the incentives. To overcome these market barriers, Roseville Electric large commercial lighting energy efficient lighting program should be continued and expanded to save energy and peak demand and reduce carbon dioxide emissions. Roseville Electric is in the process of implementing an internet rebate tracking and reporting system with crmOrbit, inc. (Energy Orbit). This system allows customers and contractors to submit rebate applications for energy efficiency and renewable energy programs. The system will track paid and reserved rebate applications, incentives paid, and energy and peak demand savings associated with the rebate including supporting documentation required for EM&V purposes. Roseville Electric staff will be able to process rebates in a secure, paperless environment.

- Assess the reliability of the verified savings and areas of uncertainty

The reliability of the verified savings is within +/-3% at the 90% +/- 10% confidence level based on average savings per measure and 27,585 measures. The primary area of uncertainty is with the effective useful life (EUL) which is assumed to be 11 years based on the DEER. The EUL for commercial lighting measures is dependent on the lighting technology and annual hours of operation. Most of the installed lighting measures are T8 or T5 lamps with electronic ballasts. The average measure life of electronic ballasts is 50,000 hours of

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operation. The average annual hours of operation are 4,163 +/- 802 hours/year based on 2 to 4 months of data collected from 22 light loggers installed at 9 customer sites. The average EUL is 12.5 +/- 2.4 years based on the mean time before failure (MTBF) of 50,000 hours for electronic ballasts and lighting operation of 4,163 +/- 803 hours per year based on light logger data. Therefore the uncertainty in the savings is +/-19.3%.

3. EM&V Approach for Commercial Lighting

The measurement and verification analysis for the study is based on the *International Performance Measurement & Verification Protocols* (IPMVP) defined **Table 3.1**.⁷ The M&V approach for the load impact evaluation involved performing on-site measurement and verification activities for a statistically significant sample of participating customers (10 of the largest sites representing 98% of the ex ante savings from a total population of 12 customers). The ex post energy and peak demand savings were determined using IPMVP Option A (i.e., partially measured retrofit isolation) and IPMVP Option B (i.e., retrofit isolation).

Table 3.1 IPMVP M&V Options

M&V Option	How Savings Are Calculated	Typical Applications
Option A. Partially Measured Retrofit Isolation Savings are determined by partial field measurement of energy use of system(s) to which a measure was applied, separate from facility energy use. Measurements may be either short-term or continuous. Partial measurement means that some but not all parameters may be stipulated, if total impact of possible stipulation errors is not significant to resultant savings. Careful review of measure design and installation will ensure that stipulated values fairly represent the probable actual value.	Engineering calculations using short term or continuous post-retrofit measurements or stipulations.	Pre- and post-retrofit Wattage values are estimated and operating hours are based on interviews with occupants, stipulated values, or measured with lighting loggers.
Option B. Retrofit Isolation Savings are determined by field measurement of the energy use of the systems to which the measure was applied, separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period.	Engineering calculations using short term or continuous measurements	Lighting system electricity use is estimated (pre) or measured (post) with a kW meter. Hours of operation are measured (post) with light loggers or power meters.
Option C. Whole Facility Savings are determined by measuring energy use (and production) at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period. Continuous measurements are based on whole-facility billing data.	Analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis or conditional demand analysis.	Energy management program affecting many systems in a building. Utility meters measure energy use for 12-month base year and throughout post-retrofit period.
Option D. Calibrated Simulation Savings are determined through simulation of the energy use of components or the whole facility. Simulation routines must be demonstrated to adequately model actual energy performance measured in the facility. This option usually requires considerable skill in calibrated simulation.	Energy use simulation, calibrated with hourly or monthly utility billing data and/or end-use metering.	Project affecting many systems in a building but where base year data are unavailable. Utility meters measure post-retrofit energy use. Base year energy use is determined by simulation using a model calibrated with post-retrofit utility data.

⁷ See *International Performance Measurement & Verification Protocols*, DOE/GO-102000-1132, October 2000. *Concepts and Options for Determining Energy and Water Savings Volume 1*, prepared by Efficiency Valuation Organization (EVO), www.evo-world.org, January 2012.

3.1 EM&V Methodology

The following EM&V methodology was used at each site.

1. Select EM&V sites from the commercial lighting program tracking database.
2. Review rebate applications for selected sites to determine EM&V plan for each site.
3. Perform site visits. Post-retrofit site inspections were performed at all sites. Sites were inspected with personnel who were familiar with the lighting retrofit to ensure a thorough understanding of the lighting retrofit project.
 - Verify pre-retrofit equipment power and hours of operation to develop the EM&V baseline of energy and peak demand (i.e., kWh/yr and kW).
 - Verify post-retrofit equipment including proper installation of all lamps, ballasts, fixtures, and controls that received rebates including make, model, fixture counts, and power use.
 - Collect data for representative lighting fixtures using light loggers, interviews, and telephone surveys (i.e., decision maker survey).
4. Perform decision maker surveys to evaluate net-to-gross ratios at the site or via telephone.
5. Perform the EM&V engineering analyses for each site based on information collected during the on-site surveys in order to evaluate energy and peak demand savings for each site consistent with IPMVP Option A (i.e., partially measured retrofit isolation) and IPMVP Option B (i.e., retrofit isolation).

EM&V site work was performed at customer sites from December 2011 through April 2012.

3.2 EM&V Algorithms for Estimating kW and kWh Savings

EM&V algorithms for estimating kW and kWh savings for each site in the random sample are based on the verified quantity of installed measures, pre- and post-installation fixture wattages and hours of operation (obtained from light loggers or maintenance personnel). Savings for each EM&V site are summed and compared to the ex ante savings to develop EM&V Average Gross Realization Rates (AGRR) for kW and kWh savings. The AGRR is combined with the Net-to-Gross Ratio (NTGR) to develop the Net Realization Rate (NRR) relative to planning.

The EM&V kW and kWh savings for each site are calculated using **Equations 1** and **2**.

$$\text{Eq. 1} \quad \text{kW Savings}_k = \sum_{k=1}^n \text{Quantity} \times [\text{kW}_{\text{pre}} - \text{kW}_{\text{post}}]$$

Where,

kW Savings_k = kW savings for site “k” in the random sample.

Quantity = Quantity of fixtures.

kW_{pre} = Pre-installation kW use per fixture.

kW_{post} = Post-installation kW use per fixture.

$$\text{Eq. 2} \quad \text{kWh Savings}_k = \sum_{j=1}^m \text{Quantity} \times [\text{kW}_{\text{pre}} - \text{kW}_{\text{post}}] \times \text{hours/year}$$

Where,

kWh Savings_k = kWh savings for site “k” in the sample.

hours/year = Hours of operation per year per fixture.

Savings for the EM&V sites are summed and compared to ex ante savings to develop Average Gross Realization Rates (AGRR) for kW and kWh savings. The AGRR for kW and kWh savings are calculated using **Equation 3**.

$$\text{Eq. 3} \quad \text{AGRR}_h = \frac{\sum_{k=1}^n \text{Ex Post Sample Savings}_k}{\sum_{k=1}^n \text{Ex Ante Sample Savings}_k}$$

Where,

AGRR_h = Average gross realization rate. Defined as the sum of EM&V savings for measures in the sample divided by ex ante savings for measures in the sample (kW or kWh).

The AGRR is combined with the Net-to-Gross Ratio (NTGR) to develop the Net Realization Rate (NRR) relative to planning. The net realization rates for kW and kWh savings are calculated using **Equation 4**.

$$\text{Eq. 4} \quad \text{NRR}_h = \text{NTGR}_h \times \text{AGRR}_h$$

Where,

NRR_h = Net Realization Rate for kW or kWh savings in program stratum “h”
 NTGR_h = Net to Gross Ratio defined as the number of units that would not have been installed without the program divided by the total number of units installed through the program (kW or kWh).

3.3 Sampling Design Approach

The statistical sample design approach for the load impact and process evaluations involved selecting a random sample of customers from the program population. Samples were selected to obtain a reasonable level of precision and accuracy at the 90% confidence level. The proposed sample design was based on statistical survey sampling methods.⁸ Sampling methods were used to analyze the data and extrapolate mean savings estimates from the sample measurements to the population of all program participants and to evaluate the statistical precision of the results.⁹

⁸ Hall, N., Barata, S., Chernick, P., Jacobs, P., Keating, K., Kushler, M., Migdal, L., Nadel, S., Prah, R., Reed, J., Vine, E., Waterbury, S., Wright, R. 2004. *The California Evaluation Framework*, Appendix to Chapter 7: 191-195. Uncertainty Calculation. San Francisco, Calif.: California Public Utilities Commission. See Table 5c, Protocols for the General Approach to Load Impact Measurement, page 14, Evaluation design decisions related to sample design will be determined by the following protocols: if the number of program participants is greater than 200 for residential programs, a sample must be randomly drawn and be sufficiently large to achieve a minimum precision of plus/minus 10% at the 90% confidence level, based on total annual energy use. A minimum of 200 for residential programs must be included in the analysis dataset for each applicable end-use. *Protocols and Procedures for Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs*, as adopted by the California Public Utilities Commission Decision 93-05-063, Revised March 1998.

⁹ Cochran, William G. *Sampling Techniques*. New York: John Wiley & Sons, 1977, Kish, Leslie. *Survey Sampling*. New York: John Wiley & Sons, 1965. Thompson, Steven K. *Sampling*. New York: John Wiley & Sons, 1992.

The **sample size** necessary to obtain the desired 10% to 20% relative precision for program mean savings estimates is calculated using **Equation 5**.

$$\text{Eq. 5} \quad \text{Sample Size} = n_i = \frac{t^2 C_{vi}^2}{r^2}$$

Where,

n_i = Required sample size for measure “i”,

t = The value of the normal deviate corresponding to the desired confidence probability of 1.28 to 1.645 at the 80 to 90% confidence level,

r = Desired relative precision, 10% to 20%.

C_{vi} = Coefficient of variation, $\frac{S_i}{\bar{y}_i}$, for measure “i.”

For small populations, the sample size is corrected using the finite population correction (FPC) equation as follows using **Equation 6**.

$$\text{Eq. 6} \quad \text{FPC Sample Size} = n_{FPCi} = \frac{n_i}{1 + (n_i - 1)/N}$$

Where,

n_{FPCi} = Sample size for measure “i” with finite population correction.

The twelve sites with the largest savings were evaluated based on detailed on-site inspections and two sites with the smallest savings were evaluated based on verification of the rebate application information. The ex ante units, proposed EM&V sample, ex post installed units, EM&V units inspected, coefficient of variation (Cv), and relative precision for each site are shown in **Table 3.2**. The coefficient of variation with respect to energy savings (kWh/yr) varies from 0.1 to 1.11 with an average of 0.60. The relative precision with respect to energy savings (kWh/yr) varies from 0.01 to 0.27 with an average of 0.02. The net-to-gross ratio (NTGR) Cv is 0.35 and the relative precision is 0.15.

Table 3.2 Sample Sizes, EM&V Inspections, and Statistics

Site	Ex Ante Units	Proposed EM&V Sample	Ex Post Installed Units	EM&V Units Inspected	Ex Post Coefficient of Variation (Cv)	Ex Post Relative Precision (r)
1	1,822	1,822	1,822	1,822	0.53	0.03
2	1,108	1,108	1,109	1,109	0.11	0.01
3	28	NA	28	NA	1.11	0.27
4	878	878	878	878	1.08	0.08
5	540	NA	540	NA	0.77	0.08
6	10,447	10,447	11,629	11,629	0.64	0.01
7	2,306	2,306	2,314	2,314	0.45	0.02
8	61	N/A	61	NA	1.05	0.22
9	1,225	1,225	1,226	1,226	0.82	0.03
10	2,251	2,251	2,251	2,251	1.05	0.03
11	134	134	428	428	1.05	0.08
12	2,379	2,379	2,379	2,379	0.53	0.02
13	2,544	2,544	2,544	2,544	0.20	0.02
14	20	NA	420	NA	0.10	0.01
Average					0.60	0.02
NTGR Participant Surveys	25,743	12	27,629	12	0.35	0.15

3.4 Process Evaluation Approach

The process evaluation approach used decision maker surveys (DMS) to measure participant satisfaction, obtain suggestions to improve the program's services and procedures, and evaluate the net-to-gross ratio (NTGR) and freerider issues. Process surveys, on-site inspections, and field measurements were used to guide the overall process evaluation in terms of investigating operational characteristics of the program and developing specific recommendations to help make the program more cost effective, efficient, and operationally effective. The process evaluation examined how the comprehensive lighting measures were installed for each customer. Interview questions assessed how the program influenced awareness of linkages between efficiency improvements and bill savings and increased efficiency or comfort for customers. Twelve participants were asked process survey questions. The participant survey instrument is provided in **Appendix B**. Participants were asked why and how they decided to participate in the program. The process survey evaluation includes a summary of what works, what doesn't work, and the level of need for the program. This information was used to define if there were issues to be addressed.

The process evaluation used surveys to measure participant satisfaction, and obtain suggestions to improve the program's services and procedures. Process surveys, on-site inspections, and field measurements were used to guide the overall process evaluation in terms of investigating operational characteristics of the program and developing specific recommendations to help make the program more cost effective, efficient, and effective. Interview questions assessed how the program influenced awareness of linkages between efficiency and bill savings and increased comfort for customers. Participants were asked why and how they decided to participate in the program. This was done to identify reasons why program marketing efforts were not successful with some customers as well as to identify additional market barriers (i.e., incentives or other inducements to achieve greater participation). Analysis of process evaluation survey data includes a summary of what works, what doesn't work, and the level of need for the program.

4. EM&V Study Findings

This section provides load impact results for the program and for each site. This section also provides the process evaluation results based on participant surveys and recommendations regarding what works, what doesn't work, and the continuing need of the program. Also provided are recommendations to increase savings, achieve greater persistence of savings, and improve customer satisfaction.

4.1 Load Impact Results

Roseville Electric implemented the large commercial lighting program at 14 sites in 2011 as shown in **Table 4.1**. The program ex ante goal was to install 25,743 energy lighting efficiency measures and Roseville accomplished 27,629 installed measures and this is 7.3% greater than the ex ante goal.

Table 4.1 Ex Ante Goals and Ex Post Accomplishments

Site	Ex Ante Goal	Ex Post Accomplishment
1	1,822	1,822
2	1,108	1,109
3	28	28
4	878	878
5	540	540
6	10,447	11,629
7	2,306	2,314
8	61	61
9	1,225	1,226
10	2,251	2,251
11	134	428
12	2,379	2,379
13	2,544	2,544
14	20	420
Total	25,743	27,629

Roseville Electric achieved 55% greater lifecycle electricity savings with ex post savings of 36,371,167 kWh versus ex ante goal of 23,468,661 kWh. Roseville exceeded the ex ante E3 Calculator Total Resource Cost (TRC) test goal by 66% with an ex post TRC of 2.98 and the ex ante TRC of 1.80 as shown in **Table 4.2**.¹⁰ The ex post TRC is greater than the ex ante TRC due to greater savings per measure due to field measurements of pre and post retrofit installations and operational hours.. Ex post accomplishments were verified by checking the tracking database, randomly inspecting 26,580 measures at 10 participant sites, installing 22 light loggers, and conducting surveys of participants, non-participants, and non-contacts. The EM&V ex post

¹⁰ Energy and Environmental Economics (E3), Inc. 2011. EE Reporting Tool 2011 (E3 Calculator). Prepared for the Northern California Power Agency (NCPA) and Southern California Public Power Authority (SCPPA), 353 Sacramento Street, Suite 1700, San Francisco, CA 94111.

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savings are based on site inspections, light logger data, and engineering analysis including light logger data from 454 fixtures and pre and post-retrofit utility billing data.

Table 4.2 Ex Ante Goals and Ex Post E3 Cost Effectiveness

Description	Ex Ante Goal	Ex Post Accomplishment
Net Annual Electricity Savings (kWh/yr)	2,133,515	3,306,470
Net Demand Savings (kW)	430	552.7
Net Lifecycle Electricity Savings (kWh)	23,468,661	36,371,167
Total Resource Cost (TRC) Test – E3	1.80	2.98
TRC Test Costs	\$1,254,693	\$1,211,260
TRC Test Benefits	\$2,266,027	\$3,503,335
TRC Test Net Benefits	\$1,011,334	\$2,292,075
Participant Test	0.34	0.34
Participant Test Costs	\$401,245	\$401,245
Participant Test Benefits	\$1,173,806	\$1,173,806
Participant Test Net Benefits	\$(772,561)	\$(772,561)

The ex ante first-year savings are summarized in **Table 4.3**. The first-year net ex ante program savings are 2,133,515 kWh and 429.7 kW, and the lifecycle savings are 23,468,661 kWh. Lifecycle savings assume the effective useful lifetime (EUL) is 11 years based on the Database for Energy Efficient Resources (DEER) EUL Summary.¹¹

Table 4.3 Ex Ante First-Year and Lifecycle Electricity Savings

Site	Ex Ante Program Quantity	Gross Ex Ante Program Savings (kW)	Gross Ex Ante Program Savings (kWh/y)	Net-to-Gross Ratio	Net Ex Ante Program Savings (kW)	Net Ex Ante Program Savings (kWh/y)	Net Ex Ante Lifecycle Savings (kWh)
1	1,822	23.83	121,802	0.85	20.25	103,532	1,138,849
2	1,108	171.11	856,405	0.85	145.44	727,944	8,007,387
3	28	1.10	9,519	0.85	0.93	8,091	89,005
4	878	5.53	47,218	0.85	4.70	40,135	441,488
5	540	4.50	38,959	0.85	3.83	33,115	364,270
6	10,447	78.03	282,569	0.85	66.32	240,184	2,642,020
7	2,306	17.34	62,639	0.85	14.74	53,243	585,675
8	61	1.08	9,355	0.85	0.92	7,951	87,466
9	1,225	79.60	658,130	0.85	67.66	559,411	6,153,516
10	2,251	52.60	170,576	0.85	44.71	144,990	1,594,886
11	134	7.32	32,475	0.85	6.23	27,604	303,641
12	2,379	21.64	76,239	0.85	18.39	64,803	712,835
13	2,544	41.08	140,911	0.85	34.92	119,774	1,317,518
14	20	0.80	3,220	0.85	0.68	2,737	30,107
Total	25,743	505.6	2,510,017	0.85	429.7	2,133,515	23,468,661

The EM&V ex post first-year savings are summarized in **Table 4.4**. The EM&V study found first-year net ex post program savings of 3,306,470 ± 94,372 kWh per year, 552.7 ± 15 kW, and lifecycle net ex post program savings of 36,371,167 ± 1,038,092 kWh. Lifecycle savings assume

¹¹ Available online: http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls.

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the EUL is 11 years based on DEER.¹² The realization rates are 1.55 ± 0.04 for kWh and for 1.29 ± 0.03 kW.

Table 4.4 Ex Post First-Year and Lifecycle Electricity Savings

Site	Ex Post Program Quantity	Gross Ex Post Program Savings (kW)	Gross Ex Post Program Savings (kWh/y)	Net-to-Gross Ratio	Net Ex Post Program Savings (kW)	Net Ex Post Program Savings (kWh/y)	Net Ex Post Lifecycle Savings (kWh)
1	1,822	22.56	118,654	0.22	5.01	26,368	290,044
2	1,109	211.18	1,331,714	0.75	158.39	998,785	10,986,638
3	28	4.29	15,330	0.89	3.81	13,627	149,896
4	878	22.85	49,948	0.89	20.31	44,399	488,385
5	540	17.73	40,400	0.89	15.76	35,911	395,019
6	11,629	122.68	703,985	0.88	107.69	617,942	6,797,367
7	2,314	25.52	45,342	0.97	24.81	44,082	484,907
8	61	3.92	7,590	0.91	3.57	6,905	75,951
9	1,226	78.90	654,412	0.99	78.02	647,140	7,118,544
10	2,251	54.66	376,889	0.94	51.62	355,950	3,915,454
11	428	44.03	310,727	0.97	42.81	302,096	3,323,056
12	2,379	39.69	219,523	0.74	29.55	163,423	1,797,648
13	2,544	40.54	180,390	0.22	9.01	40,087	440,952
14	420	3.05	12,505	0.78	2.38	9,755	107,306
Total	27,629	691.6	4,067,408	0.81	552.7	3,306,470	36,371,167

The required energy impact reporting for 2011 programs is provided in **Table 4.5**.

¹² Ibid.

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Table 4.5 Required Energy and Water Impact Reporting for 2011 Program

Program ID:		Roseville Electric Commercial Lighting Energy Efficiency Programs							
Program Name:		All							
Year	Year	Ex-ante Gross Program-Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)	Ex-Ante Gross Program-Projected Program Water CCF Savings (1)	Ex-Post Net Evaluation Confirmed Program Water CCF Savings (2)
1	2012	2,510	3,306	0.51	0.55				
2	2013	2,510	3,306	0.51	0.55				
3	2014	2,510	3,306	0.51	0.55				
4	2015	2,510	3,306	0.51	0.55				
5	2016	2,510	3,306	0.51	0.55				
6	2017	2,510	3,306	0.51	0.55				
7	2018	2,510	3,306	0.51	0.55				
8	2019	2,510	3,306	0.51	0.55				
9	2020	2,510	3,306	0.51	0.55				
10	2021	2,510	3,306	0.51	0.55				
11	2022	2,510	3,306	0.51	0.55				
12	2023								
13	2024								
14	2025								
15	2026								
16	2027								
17	2028								
18	2029								
19	2030								
20	2031								
Total		27,610	36,283						

** Peak MW savings are defined in this evaluation as the weekday peak period Monday through Friday from 2PM to 6PM during the months of May through September.

1. Gross Program-Projected savings are those savings projected by the program before NTG adjustments. 1 CCF = 748 gallons.
2. Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

The Roseville Electric energy efficiency portfolio utility cost is \$0.04/kWh and the net lifecycle green house gas (GHG) reductions are 20,156 tons. Roseville programs realized a 2.98 TRC which is 66% greater than anticipated due to installing 7.3% more measures and greater savings per site based on pre-existing fixture Wattage versus installed energy efficient fixture Wattage and light logger data regarding hours of operation.

4.2 Findings of the EM&V On-Site Audits

Findings of the EM&V on-site audits are provided in the **Tables 4.6** through **4.19**. The ex post savings are based on verification of the quantity of installed fixtures times the difference between pre-existing and installed fixture Wattages times annual hours of operation based on lighting logger data or information provided by building maintenance personnel or the Roseville Electric rebate applications. Detailed EM&V reports for each site are provided in **Appendix D**.

4.2.1 EM&V Findings for Site #1

The summary of the gross EM&V findings for site #1 are provided in **Table 4.6**. The total measure costs are \$41,448 and the total incentives are \$15,064. The total gross ex ante savings

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are 23.835 kW, 121,802 kWh/yr, and 1,339,822 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 22.557 kW, 118,655 kWh/yr, and 1,305,199 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 20.25 kW, 103,532 kWh/yr, and 1,138,849 kWh lifecycle. The ex post NTGR is 0.22. The net ex post savings are 5.01 +/- 0.48 kW, 23,368 +/- 226 kWh/yr, and 290,044 +/- 2,483 kWh lifecycle. Net ex post kW and kWh savings are 75% lower than ex ante savings due to the lower net to gross ratio (i.e., 0.22). **Appendix D-1** provides detailed findings of the EM&V on-site audit for Site #1.

Table 4.6 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #1

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Open Area Office 1-4	OccSens:Wall/Ceiling-\$44	6	2,100	0.228	918	6	4,690	0.0598	374
Open Area Office 1-4	Occ Sens: Integrated-\$40	40	2,100	1.600	6,440	40	4,690	0.490	2,744
Sales, Stock Rm, Offices	Custom Lighting	1,776	5,250	22.007	114,444	1,776	5,250	22.001	115,537
Total		1,822		23.835	121,802	1,822		22.557	118,655

4.2.2 EM&V Findings for Site #2

The summary of the gross EM&V findings for site #2 are provided in **Table 4.7**. The total measure costs are \$227,475 and the total incentives are \$65,100. The total gross ex ante savings are 171.11 kW, 856,405 kWh/yr, and 9,420,455 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 211.18 kW, 1,331,714 kWh/yr, 14,648,851 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 145.44 kW, 727,944 kWh/yr, and 8,007,387 kWh lifecycle. The ex post NTGR is 0.75. The net ex post savings are 158.39 +/- 14.25 kW, 998,785 +/- 89,891 kWh/yr, and 10,986,638 +/- 988,897 kWh lifecycle. Net ex post kW savings are 9% greater and net ex post kWh savings are 37% greater due to larger unit savings and hours of operation based on lighting logger data. **Appendix D-2** provides detailed findings of the EM&V on-site audit for Site #2.

Table 4.7 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #2

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Retail Sales Floor	Custom Remove 458W MH	739	5,005	289.56	1,449,222	739	6,306	338.46	2,134,341
Retail Sales Floor	Custom 370W MH Elec.Ballast	370	5,005	-118.45	-592,817	370	6,306	-127.28	-802,628
Total		1,109		171.11	856,405	1,109		211.18	1,331,714

4.2.3 EM&V Findings for Site #3

The summary of the gross EM&V findings for site #3 are provided in **Table 4.8**. The total measure costs are \$4,980 and the total incentives are \$4,980. The total gross ex ante savings are 1.096 kW, 9,519 kWh/yr, and 104,711 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 4.29 kW, 15,330 kWh/yr, 168,634 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 0.93 kW, 8,091 kWh/yr, and 89,005 kWh lifecycle. The ex post NTGR is 0.89. The net ex post savings are 3.19 +/- 0.56 kW, 13,627 +/- 2,008 kWh/yr, and 149,896 +/- 22,092 kWh lifecycle. Net ex post kW savings are 309% greater and net ex post kWh savings are 68% greater due to larger unit savings and hours of operation (based on interviews with school district personnel and light logger data from site #4). **Appendix D-3** provides detailed findings based on the rebate application and interviews with school district personnel.

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Table 4.8 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #3

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
School Gym	Interior HO T-5 Fixture \$250	16	1,800	0.976	8475.2	16	2683	3.58	12,125
School Gym	Occ Sens: Integrated-\$40	12	2,000	0.12	1044	12	3577	0.70	3,205
Total		28		1.096	9,519	28		4.29	15,330

4.2.4 EM&V Findings for Site #4

The summary of the gross EM&V findings for site #4 are provided in **Table 4.9**. The total measure costs are \$32,202 and the total incentives are \$13,688. The total gross ex ante savings are 5.534 kW, 47,218 kWh/yr, and 519,398 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 22.85 kW, 49,948 kWh/yr, 549,433 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 4.7 kW, 40,135 kWh/yr, and 441,488 kWh lifecycle. The ex post NTGR is 0.89. The net ex post savings are 20.31 +/- 0.2 kW, 44,399 +/- 682 kWh/yr, and 488,385 +/- 7,503 kWh lifecycle. Net ex post kW savings are 332% greater and net ex post kWh savings are 11% greater due to larger unit savings. **Appendix D-4** provides detailed findings of the EM&V on-site audit for Site #4.

Table 4.9 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #4

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
School Gym	Interior HO T-5 Fixture \$250	16	3,577	0.976	8,475	16	3,577	3.584	12,820
School Gym	Occ Sens: Integrated-\$40	12	2,683	0.12	1,044	12	2,683	0.702	2,510
Classrooms	T12 to 4ft HP T8 Sys \$10	614	1,865	1.842	14,736	614	1,865	12.285	22,911
Classrooms	4-Foot T12 Delamp \$13	236	1,865	2.596	22,963	236	1,865	6.277	11,707
Total		878		5.534	47,218	878		22.85	49,948

4.2.5 EM&V Findings for Site #5

The summary of the gross EM&V findings for site #5 are provided in **Table 4.10**. The total measure costs are \$14,543 and the total incentives are \$10,302. The total gross ex ante savings are 4.504 kW, 38,959 kWh/yr, and 428,553 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 17.73 kW, 40,400 kWh/yr, 444,400 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 3.83 kW, 33,115 kWh/yr, and 364,270 kWh lifecycle. The ex post NTGR is 0.89. The net ex post savings are 15.76 +/- 0.26 kW, 35,911 +/- 1,019 kWh/yr, and 395,019 +/- 11,213 kWh lifecycle. Net ex post kW savings are 311% greater due to larger unit savings and net ex post kWh savings are 8% greater due to slightly larger lighting logger hours of operation (based on interviews with school district personnel and light logger data from site #4). **Appendix D-5** provides detailed findings of the EM&V evaluation based on the rebate application and interviews with school district personnel.

Table 4.10 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #5

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Classrooms	T12 to 4ft HP T8 Sys \$10	278	1,865	0.834	6,672	278	1,865	7.220	13,465
Classrooms	4-Foot T12 Delamp \$13	234	1,865	2.574	22,768	234	1,865	6.222	11,605
School Gym	Interior HO T-5 Fixture \$250	16	1,865	0.976	8,475	16	3,577	3.584	12,820
School Gym	Occ Sens: Integrated-\$40	12	1,865	0.12	1,044	12	2,683	0.702	2,510
Total		540		4.504	38,959	540		17.73	40,400

4.2.6 EM&V Findings for Site #6

The summary of the gross EM&V findings for site #6 are provided in **Table 4.11**. The total measure costs are \$423,106 and the total incentives are \$100,165. The total gross ex ante savings are 78.03 kW, 282,569 kWh/yr, and 3,108,259 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 122.68 kW, 703,985 kWh/yr, 7,743,836 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 66.32 kW, 240,184 kWh/yr, and 2,642,020 kWh lifecycle. The ex post NTGR is 0.88. The net ex post savings are 107.69 +/- 3.91 kW, 617,942 +/- 22,778 kWh/yr, and 6,797,367 +/- 250,560 kWh lifecycle. Net ex post kW savings are 62% greater and net ex post kWh savings are 157% greater due to larger unit savings and lighting longer hours of operation. **Appendix D-6** provides detailed findings of the EM&V on-site audit for Site #6.

Table 4.11 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #6

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
R3 Upper	T8/T5 Lamp w/EB 2-ft \$4	16	3,333	0.096	320	16	4,427	0.17	744
Dining Services	CFL >13 watts-\$10	4	4,644	0.18	836	4	8,760	0.31	2,698
R4	Photocell sensor-\$44	12	4,077	0.312	1,272	0	3,830	0.41	2,114
R4	CFL 5-13 watts-\$5t	12	5,577	0.312	1,740	24	3,830	0.56	2,160
R4 Cafeteria	High Efficiency Exit Sign-\$60	7	7,220	0.287	2,072	7	8,760	0.26	2269
C & D	High Efficiency Exit Sign-\$60	12	7,195	0.492	3,540	12	8,760	0.44	3889
R4 Cafeteria	T8 to RW T8 Sys Retro \$8.5	780	3,333	4.68	15,600	780	8,760	15.99	140,072
C & D	Custom Lighting	1	4,380	7.847	34,370	1,239	3,830	18.17	69,599
R4 Cafeteria	CFL >13 watts-\$10	171	4,644	7.695	35,739	171	8,760	10.26	89878
Dining , R3, R4, R5	T8 to RW T8 Sys Retro \$8.5	9,354	3,333	56.124	187,080	9,376	5,132	76.10	390,562
Total		10,369		78.03	282,569	11,629		122.68	703,985

4.2.7 EM&V Findings for Site #7

The summary of the gross EM&V findings for site #7 are provided in **Table 4.12**. The total measure costs are \$60,280 and the total incentives are \$14,564. The total gross ex ante savings are 17.344 kW, 62,639 kWh/yr, and 689,029 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 25.52 kW, 45,342 kWh/yr, 689,029 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 14.74 kW, 53,243 kWh/yr, and 585,675 kWh lifecycle. The ex post NTGR is 0.97. The net ex post savings are 24.81 +/- 1.28 kW, 44,082 +/- 2,274 kWh/yr, and 484,907 +/- 25,018 kWh lifecycle. Net ex post kW savings 68% greater due to higher unit savings and NTGR and net ex post kWh savings are 17% lower due to ex post operation of 1,777 hours/year based on lighting logger data compared to ex ante operation of 2,150 hours/year. **Appendix D-7** provides details of the EM&V on-site audit for Site #7.

Table 4.12 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #7

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Classrooms	T8/T5 Lamp w/EB 4-ft-8.50	516	2,150	1.032	24,252	524	1,777	8.288	14,728
Classrooms	T8/T5 Lamp w/EB 3-ft-\$6.50	48	2,150	0.192	2,256	48	1,777	0.880	1,564
Classrooms	4-Foot T12 Delamp \$12	20	2,150	0.22	1,946	20	1,777	0.440	782
Classrooms	Custom Lighting	1,722	2,150	15.9	34,185	1,722	1,777	15.908	28,269
Total		2,306		17.344	62,639	2,314		25.52	45,342

4.2.8 EM&V Findings for Site #8

The summary of the gross EM&V findings for site #8 are provided in **Table 4.13**. The total measure costs are \$7,150 and the total incentives are \$3,596. The total gross ex ante savings are 1.078 kW, 9,355 kWh/yr, and 102,901 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 3.923 kW, 7,590 kWh/yr, 83,488 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 0.92 kW, 7,951 kWh/yr, and 87,466 kWh lifecycle. The ex post NTGR is 0.91. The net ex post savings are 3.57 +/- 0.32 kW, 6,905 +/- 621 kWh/yr, and 75,951 +/- 6,836 kWh lifecycle. Net ex post kW savings 290% greater due to higher unit savings and net ex post kWh savings are -13% lower due to 16% lower average ex post operation of 1,688 hours/year compared to ex ante operation of 2,000 hours/year. **Appendix D-8** provides detailed findings based on the rebate application.

Table 4.13 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #8

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Garage	Interior HO T-5 Fixture \$250	12	2,000	0.732	6,356	12	1,800	2.642	5,284
Garage	4-Foot T12 Delamp \$13	24	2,000	0.264	2,335	24	1,800	0.558	1,004
Gym	T12 to 4ft HP T8 Sys \$10	24	2,000	0.072	576	24	1,800	0.558	1,004
Gym	OccSens:Wall/Ceiling-\$44	1	2,000	0.01	87	1	1,350	0.165	297
Total		61		1.078	9,355	61		3.923	7,590

4.2.9 EM&V Findings for Site #9

The summary of the gross EM&V findings for site #9 are provided in **Table 4.14**. The total measure costs are \$138,288 and the total incentives are \$57,324. The total gross ex ante savings are 79.6 kW, 658,130 kWh/yr, and 7,239,430 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 78.9 kW, 654,412 kWh/yr, 7,198,527 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 67.66 kW, 559,411 kWh/yr, and 6,153,516 kWh lifecycle. The ex post NTGR is 0.99. The net ex post savings are 78.02 +/- 1.12 kW, 647,140 +/- 9,296 kWh/yr, and 7,118,544 +/- 102,251 kWh lifecycle. Net ex post kW savings are 15.3% greater due to higher unit savings and NTGR and net ex post kWh savings are 15.7% greater due to slightly greater ex post operation of 2010 hours/year based on lighting logger data compared to ex ante operation of 2,000 hours/year. **Appendix D-9** provides detailed findings of the EM&V on-site audit for Site #9.

Table 4.14 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #9

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
MOB1	OccSens:Wallbox-\$40	25	2,000	0.775	4,600	25	2,010	0.727	4,318
MOB1	OccSens:Wallbox-\$41	422	2,000	13.082	77,648	422	2,010	12.280	72,888
Parking/Elevator/etc.	Custom Lighting	1	8,760	65.74	575,882	779	8,760	65.891	577,205
Total		448		79.60	658,130	1226		78.90	654,412

4.2.10 EM&V Findings for Site #10

The summary of the gross EM&V findings for site #10 are provided in **Table 4.15**. The total measure costs are \$58,032 and the total incentives are \$28,429. The total gross ex ante savings are 52.6 kW, 170,576 kWh/yr, and 1,876,336 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 54.66 kW, 376,889 kWh/yr, 4,145,775 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 44.71 kW, 144,990 kWh/yr, and 1,594,886 kWh lifecycle. The ex post NTGR is 0.94. The net ex post savings are 51.62 +/- 0.63 kW, 355,950 +/-

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4,845 kWh/yr, and 3,915,454 +/- 53,296 kWh lifecycle. Net ex post kW savings are 15.4% greater due to higher unit savings and NTGR and net ex post kWh savings are 146% greater due to 49% greater average ex post operation of 7,144 hours/year based on lighting logger data compared to average ex ante operation of 4,794 hours/year. **Appendix D-10** provides detailed findings of the EM&V on-site audit for Site #10.

Table 4.15 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #10

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Phase 6	Interior HO T-5 Fixture \$250	10	8,684	0.61	5,297	60	8,473	2.37	20,081
Phase 1, 2, 3	Custom Lighting	1	8,473	3.575	2,145	20	8,473	4.647	36,331
Phase 1, 6	T8/T5 Lamp w/EB 8-ft \$15	61	3,333	0.732	2,440	61	8,473	3.653	30,952
Phase 4	CFI > 13 watts \$10	14	4,644	0.63	2,926	14	4,940	0.23	1,136
Phase 1, 3, 4, 6	OccSens:Wallbox-\$40	31	4,025	1.24	4,991	31	6,343	2.76	15,778
Phase 1, 6	Occ Sens: Integrated-\$40	35	4,025	1.4	5,635	35	8,473	0.19	1,689
Phase 1, 6	8 Foot T12 Delamp	57	3,325	4.389	14,592	57	8,473	4.047	34,290
Phase 2, 3, 4	T8/T5 Lamp w/EB 4-ft-8.50	1318	3,333	11.862	39,540	1318	5,374	11.21	72,110
Phase 2, 3, 4	4-Foot T12 Delamp \$12	655	3,302	28.165	93,010	655	5,278	25.55	164,521
Total		2,182		52.60	170,576	2,251		54.66	376,889

4.2.11 EM&V Findings for Site #11

The summary of the gross EM&V findings for site #11 are provided in **Table 4.16**. The total measure costs are \$34,934 and the total incentives are \$34,851. The total gross ex ante savings are 7.32 kW, 32,475 kWh/yr, and 357,225 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 44.03 kW, 310,727 kWh/yr, 3,418,001 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 46.23 kW, 27,604 kWh/yr, and 303,641 kWh lifecycle. The ex post NTGR is 0.97. The net ex post savings are 42.81 +/- 1.86 kW, 302,096 +/- 13,549 kWh/yr, and 3,323,056 +/- 149,040 kWh lifecycle. Net ex post kW savings are 588% greater due to higher unit savings and NTGR and net ex post kWh savings are 994% greater due to greater unit savings, NTGR, and 23% greater ex post operation of 5,780 hours/year based on lighting logger data compared to average ex ante operation of 4,712 hours/year. **Appendix D-11** provides detailed findings of the EM&V on-site audit for Site #11.

Table 4.16 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #11

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
1st Floor	Custom Lighting	1	5,739	2.669	15,318	263	4,327	2.67	11,549
Warehouse, Mqfring	Interior HO T-5 Fixture \$250	133	3,686	4.655	17,157	165	7,233	41.363	299,179
Total		134		7.32	32,475	428		44.03	310,727

4.2.12 EM&V Findings for Site #12

The summary of the gross EM&V findings for site #12 are provided in **Table 4.17**. The total measure costs are \$43,467 and the total incentives are \$28,224. The total gross ex ante savings are 21.64 kW, 76,239 kWh/yr, and 838,629 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 39.69 kW, 219,523 kWh/yr, 2,414,751 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 18.39 kW, 64,803 kWh/yr, and 2,414,751 kWh lifecycle. The ex post NTGR is 0.74. The net ex post savings are 29.55 kW, 163,423 kWh/yr, and 1,797.648 kWh lifecycle. Net ex post kW savings 61% greater due to higher unit savings and net ex post kWh savings are 152% greater due to average ex post operation of 5,505 hours/year

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based on lighting logger data compared to average ex ante operation of 2,379 hours/year. **Appendix D-12** provides detailed findings of the EM&V on-site audit for Site #12.

Table 4.17 Summary of Ex Ante and Ex Post EM&V Findings for Site #12

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Bldg A-D Light Logger ave	T12 to 4ft RW T8 Sys \$12	1,673	3,556	15.057	53,536	1,673	5,591	32.845	183,635
Bldg A Light Logger data	4-Foot T12 Delamp \$13	3	3,686	0.105	387	3	6,112	0.140	398
Bldg A Light Logger data	T8 to RW T8 Sys Retro \$8.5	64	3,333	0.384	1,280	64	6,112	1.024	6,259
Bldg B Light Logger data	T8 to RW T8 Sys Retro \$8.5	6	3,333	0.036	120	6	2,749	0.282	775
Bldg D Light Logger data	T8 to RW T8 Sys Retro \$8.5	536	3,333	3.216	10,720	536	6,007	2.906	17,216
Bldg A Light Logger data	4-Foot T12 Delamp \$13	14	3,686	0.49	1,806	14	6,112	0.651	1,857
Bldg A Light Logger data	T8/T5 Lamp w/EB 3-ft \$6	8	3,615	0.104	376	8	6,112	0.140	856
Bldg D Light Logger data	T8/T5 Lamp w/EB 3-ft \$6	8	3,615	0.104	376	8	6,007	0.140	841
Bldg A-D Light Logger ave	OccSens:Wallbox-\$40	67	3,563	2.144	7,638	67	4,743	1.565	7,686
Total		2,379		21.64	76,239	2,379		39.69	219,523

4.2.13 EM&V Findings for Site #13

The summary of the gross EM&V findings for site #13 are provided in **Table 4.18**. The total measure costs are \$86,301 and the total incentives are \$24,649. The total gross ex ante savings are 41.08 kW, 140,911 kWh/yr, and 1,550,021 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 40.54 kW, 180,390 kWh/yr, 1,984,286 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 34.92 kW, 119,774 kWh/yr, and 1,317,518 kWh lifecycle. The ex post NTGR is 0.22. The net ex post savings are 9.01 +/- 0.29 kW, 40,087 +/- 1,305 kWh/yr, and 440,952 +/- 14,351 kWh lifecycle. Net ex post kW savings are 74% and net ex post kWh savings are 67% less due the 0.22 NTGR. **Appendix D-13** provides detailed findings of the EM&V on-site audit for Site #13.

Table 4.18 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #13

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Retail	Custom Lighting	1	3,430	41.082	140,911	2,544	4,450	40.54	180,390
Total		1		41.08	140,911	2,544		40.54	180,390

4.2.14 EM&V Findings for Site #14

The summary of the gross EM&V findings for site #14 are provided in **Table 4.19**. The total measure costs are \$1,550 and the total incentives are \$808. The total gross ex ante savings are 0.8 kW, 3,220 kWh/yr, and 137,555 kWh lifecycle assuming an EUL of 11 years. The total gross ex post savings are 3.05 kW, 12,505 kWh/yr, 35,420 kWh lifecycle. The ex ante NTGR is 0.85. Total net ex ante savings are 0.68 kW, 2,737 kWh/yr, and 30,107 kWh lifecycle. The ex post NTGR is 0.22. The net ex post savings are 2.38 +/- 0.16 kW, 9,755 +/- 640 kWh/yr, and 107,306 +/- 7,039 kWh lifecycle. Net ex post kW savings 250% greater and net ex post kWh savings are 256% greater due to higher unit savings. **Appendix D-14** provides detailed findings based on the rebate application.

Table 4.19 Summary of Gross Ex Ante and Ex Post EM&V Findings for Site #14

Location	Measure	Ex Ante Qty	Ex Ante h/y	Gross Ex Ante kW	Gross Ex Ante kWh/y	Ex Post Qty	Ex Post h/y	Gross Ex Post kW	Gross Ex Post kWh/y
Office	OccSens:Wallbox-\$40	18	4,025	0.720	2,898	378	3,075	2.75	11,255
Office	OccSens:Wall/Ceiling-\$44	2	4,025	0.080	322	42	3,075	0.31	1,251
Total		20		0.80	3,220	420		3.05	12,505

4.3 Participant Survey Results

This EM&V study used participant surveys to estimate the net-to-gross ratios (NTGR) for kWh and kW savings (see **Appendix B**). Participant surveys were completed for 10 participants and the weighted average NTGR for the commercial lighting program is 0.81.

4.3.1 Participant Survey Methodology

Participant surveys are used to evaluate retention (i.e., measures still installed), pre-retrofit Watts, hours of operation, and time-of-use. The participant surveys were also used to evaluate net-to-gross ratios (NTGR) for calculating net kW and kWh savings. The NTGR is used to estimate the fraction of free riders who would have otherwise implemented lighting improvements in the absence of the program. **Table 4.20** provides the NTGR participant survey questions and scores. The NTGR score for each completed participant survey is the average score based on answers to questions 5 through 13. No score is assigned to responses of “don’t know”, “refused to answer,” or “other.”

Table 4.20 Net-to-Gross Ratio Participant Survey Questions and Scores

#	Question	Answer	Score
1	Are you using the energy efficient lighting that you purchased with rebates from Roseville Electric?	Yes, No	1=Y, 2=0
2	How many hours per year are the lights on? Clarify, not just when the business is open, but lights are actually on. Think about early arrivals, late janitorial service, etc...	<3, 4.5, 6, DK	
3	Are your lights turned on from 2-6PM weekdays (i.e., peak period)?	Yes, No	1=Y, 2=N
4	When and how did you first learn about the utility energy efficiency program?	Yes, No	1=Y, 2=N
5	Did you understand the value of the program BEFORE or AFTER you installed the efficiency upgrades?	Before	1
		After	0
6	Did you install the energy efficiency measures BEFORE or AFTER you heard about the Program?	Before	0
		After	1
7	On a scale from 0 to 10, with 0 being no influence at all and 10 being very influential, how much influence did the Utility or Rebates have on your decision to install the efficiency upgrades?	0 to 10	0=0, 10=1
8	If the Rebates had not been available, how likely is it you would have done exactly the same thing. Please use a scale from 0 to 10, with 0 being not at all likely and 10 being very likely.	0 to 10	0=1, 10=0
9	What role did the utility program play in your decision to install the measures?	1 = Reminded	0.25
		2 = Speeded Up (i.e., early replacement)	0.5
		3 = Showed Benefits Didn't Know Before	1
		4 = Clarified Benefits	0.75
		5 = No role	0
10	The utility program was nice but not necessary to have the measures installed. (0=Disagree, 10=Agree).	0 to 10	0=0, 10=1
11	I would not have purchased or installed the Energy Star® appliances or measures without the Utility Program rebates or information.	0 to 10	0=0, 10=1
12	The utility program was a critical factor in installing the measures? (0=Disagree, 10=Agree).	0 to 10	0=1, 10=0
13	We would not have installed measures without the utility program. (0=Disagree, 10=Agree).	0 to 10	0=1, 10=0
14	If you had not received the incentives from the utility, when would you have installed the lighting measures?	Within 6 months	0
		< 1 year	0.125
		1 to 2 years	0.25
		2 to 3 years	0.5
		3 to 4 years	0.75
		4 or more years	1
		Never	1

4.3.2 Findings of the Participant Surveys

Results of the participant surveys are presented in **Table 4.21**. The weighted average NTGR is 0.81. The participant findings indicate that approximately 100% of customers were very satisfied with the program. This indicates that Roseville has been successful in motivating their customers to participate in the program.

Table 4.21 Participant Survey Findings

Site	Units Installed	NTGR
1	1,822	0.22
2	1,108	0.75
3	28	0.89
4	878	0.89
5	540	0.89
6	10,447	0.88
7	2,306	0.97
8	61	NA
9	1,225	0.99
10	2,251	0.94
11	134	0.97
12	2,379	0.74
13	2,544	0.22
14	20	NA
Total	25,743	0.81

4.4 Process Evaluation Results

Process evaluation recommendations are based on process surveys conducted in-person with 10 participants. The process surveys were used to evaluate participant satisfaction and obtain suggestions to improve the program's services and procedures. Interview questions assessed how the program influenced awareness of linkages between efficiency improvements, bill savings, and increased comfort for customers. Participants were asked why and how they decided to participate in the program. Non-participants were asked why they chose not to participate. Non-contacted customers were asked if they would have participated had they been made aware of the program. The surveys identified reasons why program marketing efforts were not successful with non-participants as well as to identify additional hard-to-reach market barriers. The process survey instrument is provided in **Appendix B**.

4.4.1 Participant Survey Results

Participant survey results are summarized to answer the following questions.

1. Are participants satisfied with services or information provided by the program?

Participant satisfaction is very high as indicated by the following survey responses.

- Overall Satisfaction with Program – 100 percent satisfaction rating (i.e., average score of 10 out of 10 points).

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- Presentation of information – 100 percent satisfaction rating (i.e., 10 out of 10 points).
- Increased Understanding of Link between Energy Efficiency, Savings, and Comfort – 82.5 ± 7 percent, indicating Roseville energy education efforts are doing a good job.

2. Are customers satisfied with measures offered or installed by the program?

Customers were satisfied with measures as indicated by the following ratings.

- 100 percent of customers are still using the measures installed by the program.
- 100% of customers are satisfied with measures offered or installed by the program ((i.e., average score of 10 out of 10 points).

3. Are customers satisfied with services or information provided by the program?

Customer satisfaction with the services or information provided by the program is indicated by the following customer ratings.

- 100 percent presentation rating.
- 100 percent accuracy rating.
- 82.5 ± 7 percent rating of program increasing understanding of the linkage between energy efficiency, bill savings, and comfort.

4. What are the participant demographics?

- Average conditioned floor area is $122,800 \text{ ft}^2 \pm 80,843 \text{ ft}^2$.
- Average number of occupants is 280 ± 157 .
- 92% of customers owned their building and 8% are tenants.

5. Do participants have any suggestions to improve the program?

Five participants provided comments or suggestions to improve the program.

- Four participants said “great program, very satisfied with program and measures, or happy with the new energy efficient lighting systems.”
- One participant said the program they “had some issues with the lighting at first but the contractor corrected the problems and they are very happy with project.”

6. Did participants share information with friends or neighbors about the benefits of measures offered by the program (i.e., multiplier effects)?

None of the participants interviewed customers shared program information with other customers or businesses in the Roseville Electric service territory.

The following section provides process evaluation recommendations to improve the program.

4.4.2 Process Evaluation Recommendations

The following process evaluation recommendations are provided as per the EM&V plan regarding what works, what doesn't work, and suggestions to improve the program's services and procedures.

4.4.2.1 Recommendations for Database

Roseville Electric is in the process of implementing an internet rebate tracking and reporting system with crmOrbit, inc. (Energy Orbit). This system allows customers and contractors to submit rebate applications for energy efficiency and renewable energy programs. The system will track paid and reserved rebate applications, incentives paid, energy and peak demand savings associated with the rebate including supporting documentation required for EM&V purposes. Roseville Electric staff will be able to process rebates in a secure, paperless environment.

4.4.2.2 Recommendations for the Commercial Lighting Program

Based on findings from this study, many large commercial customers (81%) do not have sufficient capital or motivation to invest in improving the energy efficiency of their lighting systems without incentives from Roseville Electric. To overcome these market barriers, Roseville Electric energy efficiency programs should be continued and expanded to save energy and peak demand and reduce carbon dioxide emissions.

Appendix A: CEC EM&V Check List

Contextual Reporting

- Clearly state savings values and compare to the associated SB 1037 annual report.
- What portion of the portfolio is covered? Describe the programs or savings not evaluated?
- Assess risk or uncertainty in selecting the components of the portfolio to evaluate.

Overview and Documentation of Specific Evaluation Effort

- Clearly identify what is being evaluated in the study (part of a program; an entire program; the entire portfolio).
- Include an assessment of EUL and lifecycle savings.
- Provide documentation of all engineering and billing analysis algorithms, assumptions, survey instruments and explanation of methods.
- Describe the methodology in sufficient detail that another evaluator could replicate the study and achieve similar results.
- Include all data collection instruments in an appendix.
- Describe metering equipment and protocols in an appendix.

Gross Savings

- Review the program's choice of baseline.
- Characterize the population of participants.
- Discuss the sampling approach and sample design.
- State the sampling precision targets and achieved precision.
- Present ex post savings.
- Expand the results to the program population. If not, state why not and clearly indicate where ex ante savings are being passed through.
- Explain any differences between ex ante and ex post savings.

Net Savings

- Include a quantitative assessment of net-to-gross. If not, clearly indicate the source of the assumed net-to-gross value.
- Discuss the sampling approach and sample design.
- If a self-report method is used, does the approach account for free-ridership?

EM&V Summary and Conclusions

- Provide clear recommendations for improving program processes to achieve measurable and cost-effective energy savings.
- Assess the reliability of the verified savings and areas of uncertainty.

Appendix B: Roseville Electric Commercial Lighting Decision-Maker Survey

Interview Instructions for Decision-Maker Survey

1. Purpose

The purpose of the Decision-Maker Survey is to obtain sufficient information to improve the program, calculate gross savings and the Net-to-Gross Ratio (NTGR). You will need to interview the customer who was responsible for the decision to install the Roseville Electric commercial lighting energy efficiency measures. If this person is unavailable attempt to locate someone who is at least familiar with how that decision was made.

2. Selection of Respondent

The **decision-maker** must be the person who decided to participate in the program.

3. Selection of Respondent

1. **Participants** must be the person responsible for allowing program measures to be installed at the site. If this person is unavailable locate someone who is at least familiar with how that decision was made.

4. Two Types of Sites

This survey will be used for two types of sites:

1. **On-Site EM&V Only.** Sites that receive an EM&V on-site inspection or process survey.
2. **Telephone Only.** Sites that only receive a telephone survey (participants or non-participants).

5. How to Start a Survey

Complete the following steps to start one of these surveys:

1. Review Roseville Electric customer file information (for participants).
2. Make sure you understand what was installed with incentives from Roseville Electric prior to initiating the visit or call.
3. Participant or Decision Maker Survey Introduction.
Say: "Hello! My name is [_____], and I am conducting a survey regarding the Roseville Electric Commercial Lighting Energy Efficiency Programs. The programs provided free information, rebates, and no-cost energy efficiency measures for your business. Funding for the program is from Roseville Electric. Would you mind spending 10 minutes to answer a few questions to help us evaluate and improve the program?"

Roseville Electric PARTICIPANT SURVEY

Business Name: _____
Customer Name: _____
Phone Number: _____
Start Call Time: _____
Surveyor Initials: _____

Business Type/ID: _____
Date: _____
City: _____
End Call time: _____
Survey Completed: Y NA R WB BN

Y = yes, NA = no answer, R = refused, WB = wrong business, BN = bad number

Participant Survey

- 1. Do you remember Roseville Electric providing rebates for energy efficient lighting for your business?
2. If yes, how satisfied were you with the Roseville Electric rebates on a scale from 1 to 10?
3. If yes, on a scale from 1 to 10 how satisfied were you with the information provided by Roseville Electric on energy efficiency lighting?
4. How would you rate the amount of light output from the energy efficient lighting as compared to your previous lighting system on a scale from 1 to 10?
5. How would you rate the color output of the energy efficient lighting to the previous lamps on a scale from 1 to 10?
6. How would you rate the Roseville Electric program in terms of presentation on a scale from 1 to 10 (i.e., rebate application, website, meetings with personnel regarding rebate program)?
7. How would you rate the information about energy savings in terms of accuracy on a scale from 1 to 10 (i.e., estimation of energy savings resulting from rebated measures provided by the lighting contractor)?
8. How would you rate the overall energy efficiency services you received from Roseville Electric on a scale from 1 to 10?
9. How would you rate the program or utility representative in terms of increasing your understanding of the link between energy efficiency, bill savings, and comfort?
10. To the best of your knowledge is everything installed correctly?
11. Are you still using all the measures that were installed?
12. Were there any measures for which you received rebates that you have since had removed? (i.e., check Roseville Electric database to verify installation)?

Roseville Electric PARTICIPANT SURVEY (cont'd) # _____

13. Have you shared information with any of your business acquaintances about the benefits of energy efficient lighting from the Roseville Electric program?

___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

With how many other businesses have you shared this information in the last 12 months? _____

About how many of these people have installed any of these measures? _____

14. Do you know any other business acquaintances that would benefit from this program (name/address)? _____

15. Please verify the quantity of Roseville Electric energy measures installed? The following table is completed by surveyor prior to interview based on Roseville Electric rebate application data.

#	Energy Efficiency Measures	Qty. Roseville Electric Database	Qty. Verified Installed	Annual Hours of Operation (hrs/year)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

16. Please provide the following demographic information?

___ # Occupants ___ Own or Lease Building ___ Floor Area **99** Refused

17. Do you have any suggestions to improve the program?

___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

If so, please provide the suggestion(s). _____

DECISION-MAKER SURVEY

Business Name: _____

Business Type: _____

Customer Name: _____

Date: _____

Phone Number: _____

City: _____

Start Call Time: _____

End Call time: _____

Surveyor Initials: _____

Survey Completed: Y NA R WB BN

Y = yes, NA = no answer, R = refused, WB = wrong business, BN = bad number

The purpose of the decision-maker survey is to obtain information necessary to calculate a net-to-gross ratio. You will need to interview the customer who was responsible for the decision to implement measures at the site. If this person is not available attempt to locate someone who is at least familiar with how that decision was made.

Introduction

Say: "Hello. My name is [_____] and I am conducting a survey regarding the Roseville Electric energy efficiency programs. Would you mind spending 5 minutes to answer a few questions to help us evaluate the programs?"

Begin Survey

- 1. Are you using the energy efficient lighting that you purchased with rebates from Roseville Electric?
2. How many hours per year are the lights on? Clarify, not just when the business is open, but lights are actually on.
3. When and how did you first learn about the Lighting Rebate Program?
4. Keeping that in mind, did you understand the value of the program BEFORE or AFTER you installed the energy efficient lighting?
5. Did you install energy efficient lighting measures BEFORE or AFTER you received information, rebates from the utility?
6. On a scale from 0 to 10, with 0 being no influence at all and 10 being very influential, how much influence did the Utility or Rebate have on your decision to install the energy efficiency measures?
7. If rebates had not been available, how likely is it you would have done exactly the same thing. Please use scale from 0 to 10, with 0 being not likely and 10 very likely.

Notes: _____

Special Instruction for Contradictory Responses: If [Q.6 is 0,1,2 and Q.7 is 0,1,2] or [Q.6 is 8,9,10 and Q.7 is 8,9,10]. Find the explanation. Do not communicate a challenging attitude when posing the question. For example, say,

When you answered "8" for the question about the influence of the rebate or service, I interpreted that to mean that the Utility Program was important to your decision. Then, when you answered "8" for how likely you would be to take the same action without the rebate or service, it sounds like the Utility was not very important. I want to check to see if I understand your answers or if the questions may have been unclear. If they volunteer a helpful answer at this point, respond by changing the appropriate answer. If not, follow up with something like: "Would you explain in your own words, the role the Utility Program played in your decision to take this action?"

If possible translate their answer into responses for Questions 6 and 7 and check these responses with the respondent for accuracy. If the answer doesn't allow you to decide what answer should be changed, write the answer down and continue the interview.

Answer: _____

DECISION-MAKER SURVEY (Continued)

8. What role did the Utility Account Representative play in your decision to install energy efficient lighting?
[Prompt by reading list if the respondent has trouble answering.]

- 1 Reminded us of something we already knew
- 2 Sped up the process of what we would have done anyway (i.e., early replacement)
- 3 Showed us the benefits of this action that we didn't know before
- 4 Clarified benefits that we were *somewhat* aware of before
- 5 Recommendation had no role
- 6 Other _____
- 98 Don't Know
- 99 Refused to Answer

Say: Here are some statements that may be more or less applicable for your business about the Roseville Electric Rebate Program [or recommendation]. Please assign a number between 0 and 10 to register how applicable it is. A 10 indicates that you fully agree, and 0 indicates that you completely disagree.

- 9. Utility Rebate was nice but unnecessary for me to install efficient lighting.
___ Response (0-10) 98 Don't Know 99 Refused to Answer
- 10. Utility Rebate was a critical factor to install efficient lighting.
___ Response (0-10) 98 Don't Know 99 Refused to Answer
- 11. We would not have installed the efficient lighting without the Utility Rebate.
___ Response (0-10) 98 Don't Know 99 Refused to Answer

Special Instruction for Contradictory Responses: If [Q.9 is 0,1,2, and Q.10/11 is 8,9,10] or [Q.9 is 8,9,10 and Q.10/11 is 0,1,2]. When you answered "8, 9 or 10" for the question about "the Utility Program being 'nice' but unnecessary," I interpreted that to mean that the Utility Program was unimportant to your decision. Then, you answered "8, 9 or 10" for "the Utility Program being a critical factor." I want to check to see if I understand your response. If they volunteer a helpful answer, respond by changing the appropriate answer. If not, follow up with something like: "Would you explain in your own words, why the Utility Program was a critical factor in your decision?"

If possible translate their answer into responses for **Questions 9/10/11**. If the answer doesn't allow you to decide what answer should be changed, write the answer down and continue the interview.

Answer: _____

- 12. If you hadn't received efficient lighting rebates from Roseville Electric would you have installed the same measures ...
 - 1 ..within 6 months?
 - 2 ..6 months to 1 year?
 - 3 ..one to two years later?
 - 4 ..two to three years later?
 - 5 ..three to four years later?
 - 6 ..four or more years later?
 - 7 ..Never
 - 98 ..Don't Know - **Try less precise response, if still "don't know" use 98**
 - 8 ...less than one year?
 - 9 ...one year or more?
 - 99 ...Refused to Answer

Time relative to the installation date. For customers with more than one measure ask if their response is the same. If not, obtain a response for each measure. Write answers in margins and enter answers on a new line in the Excel spreadsheet.

Appendix C: Light Logger Metering Equipment Protocols

The lighting logger metering equipment protocol requires determination of how many unique lighting areas or fixture groups are in the building. At least one lighting logger is installed in each unique lighting area or fixture group. A representative fixture is selected for the area to install a lighting logger. Lighting loggers are identified with a custom sticker identifying the logger number, building, location, and fixture. This data is entered into the Lighting Logger tracking database. Approximately 1 to 5 lighting loggers are installed per site. A maximum of 5 lighting loggers are installed at sites with more than one unique area and different lighting usage patterns. A return visit is scheduled with on-site personnel to collect the loggers from 2 to 8 weeks after installation (longer if there are holidays during the installed period). Refer to the installation instructions provided by Dent Instruments regarding installation of the lighting loggers. The following installation protocol is required to ensure proper installation of light logger metering equipment.

1. Identify the unique lighting area or fixture group. Find a fixture within the group that has hours of operation representative of the unique lighting area. The selected fixture must have the same control strategy as the entire group of fixtures.
2. If the fixture has a wall switch, turn it off and on. This is done to confirm the selected lights are controlled by a switch. Lights that do not turn off with the switch are security fixtures that operate 24 hours and security fixtures are not selected for light logger installation.
3. Identify ambient light sources. Do not install loggers on fixtures that may be subject to “false” recordings due to ambient light triggering the logger. Be sure to consider the ambient light exposure throughout the day. The sun may not be a problem at the time of installation, but could have a negative effect during a different period of the day.
4. Visually inspect the fixture. If necessary, open the fixture. Take care not to damage the lens or fixture. If there appears to be any previous damage or problem with the fixture notify the site personnel so they are aware of any pre-existing conditions.
5. Make sure the pre-printed identification sticker on the logger is marked to indicate the site, to identify site name, location in building, date and time, and number of fixtures controlled.
6. Adjust lighting level threshold (sensitivity) on lighting logger by holding it about 2 feet from the lamp. Using a small flat screwdriver, slowly adjust the sensitivity of the logger so that the display reads “on” only when the fixture is on. This is done by setting the sensitivity low and slowly adjusting it until the logger is triggered. Turn the sensitivity approximately $\frac{1}{4}$ turn past that point.
7. Test the logger operation by turning off the fixture and checking that the logger reads “off”. Turn it back on and check the display for “on”. If you cannot operate the fixture control (e.g., an occupancy sensor controls the light), then you can remove one of the lamps to disable the light depending on the wiring scheme of the ballast.
8. When the logger is properly installed, before closing the fixture, press the reset button on the logger to delete all previous data. Only a trained EM&V engineer is allowed to reset the logger using a computer after data has been collected.
9. Place lighting logger in fixture. Loggers can be placed in many fixtures using the magnetic strip attached to the logger. Double-sided tape may need to be used with other types of

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fixtures to hold the logger in the fixture. Take care with reflective fixtures not to diminish the reflective qualities. Many fixtures have lens covers that need to be opened to install the loggers. For these types of fixtures, the loggers are placed so that the light sensor is looking at the lamp. Too much heat can damage the logger. As a guide, if you can hold your hand there for a minute then the logger should be okay.

10. After the logger has been placed in the fixture confirm the logger display shows “ON” when the lights are on.
11. In the EM&V tracking database record the logger serial number, site name, location in building, date and time, and number of fixtures controlled. Describe the location of the logger so someone else can find it and so it identifies the area usage type. Identify the space type where the logger has been placed and what percentage of the building the logger represents. Account for as much of the building as possible. Also note any special conditions such as occupancy sensors, daylight area, only used at night, etc.
12. Place a colored sticker on the outside of the fixture frame so it can be identified as someone walks up to it.
13. Make sure someone at the site knows where the lighting loggers have been placed and will keep an eye out until you return to remove them. Write their name on the Installation Form.

Appendix D-1: Lighting Rebate Site #1

EM&V REPORT FOR LIGHTING SITE #1

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #1
Site Name: Site #1
Site Address: 1252 Galleria Boulevard, Roseville, CA 95678
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #1

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #1	n/a	Lighting	Roseville	Comm. Lighting	15,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #1	Lighting	23.83	121,802	n/a	15,064

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #1	Lighting	22.56	118,654	n/a	41,448

Spillover

No evidence of spillover was found.

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Impact Evaluation Report: Roseville Electric

End Use: LIGHTING

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #1. The Roseville Electric rebates are provided in Table 1. For 1,822 reported measures the total rebate was \$15,064. The EM&V findings are based on installed fixtures including lamps and ballasts. The program tracks quantities of measures rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #1

Measure	Description	Qty.	Location
1	OccSens:Wall/Ceiling-\$44	6	Open Area Office 1-4
2	Occ Sens: Integrated-\$40	40	Open Area Office 1-4
3	Custom Lighting	1,776	Sales, Stock Room, Offices
Total		1,822	

Verified Efficiency Improvement: Based on site inspections, the following energy efficiency improvements were made under this project at Site #1.

Table 2. Verified Efficiency Improvements at Site #1

Measure	Description	Qty.	Location
1	OccSens:Wall/Ceiling-\$44	6	Open Area Office 1-4
2	Occ Sens: Integrated-\$40	40	Open Area Office 1-4
3	Custom Lighting	1,776	Sales, Stock Room, Offices
Total		1,822	

Primary Business Descriptions: Site #1 consists of retail, storage and office space.

Variability in Schedule and Production: Discussions were held with personnel at the building to determine pre-existing lighting hours of use. Lighting loggers were installed at representative locations in the facility to determine ex post operational hours. These hours are reflected in the lighting surveys for the pre-installation and as-built conditions for each building.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V on-site audit for site #1 are provided in **Table 3**.

Table 3. Findings of the EM&V On-Site Audits for Site #1

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
SALES FLOOR	203	(2) 4L F32T8 8' Industrial Strip Channel- .88 BF	220	SR 16T 132 UV 1HI W - 16' Retrofit Kit, (4) F32T8/XL/SPX41/HL	203	145	5250	5250	15.23	79,931
SALES FLOOR	10	(1) 4L F32T8 8' Ind Strip Channel & (1) 2L F32T8 4'	166	SR 12T 132 UV 1HI W - 12' Retrofit Kit, (3) F32T8/XL/SPX41/HL	10	117	5250	5250	0.49	2,573

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Table 3. Findings of the EM&V On-Site Audits for Site #1

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
		Ind Strip Channel .88 BF								
SALES FLOOR	84	4L F32T8 8' Industrial Strip Channel - .88 BF	110	SR 8T 132 UV 1HI W - 8' Retrofit Kit, (2) F32T8/XL/SPX41/HL	84	73	5250	5250	3.11	16,317
SALES FLOOR	3	2L F32T8 4' Industrial Strip Channel - .88 BF	56	SR 132 UV 1HI W - 4' Retrofit Kit, (1) F32T8/XL/SPX41/HL	3	41	5250	5250	0.05	236
BEDDING VALANCE	0	2L 3' F25T8/XL/SPX41	46	Disconnect / De-energize	0	0				
HALL: Public	1	3L 2x4 Flat Prismatic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W - 1L F32T8/XL/SPX41/HL	1	41	5250	5250	0.05	252
LADIES REST ROOM	2	2L 2x4 Flat Prismatic - F32T8/XL/SPX41	56	TR 24 132 UV 1HI W - 1L F32T8/XL/SPX41/HL	2	41	5250	5250	0.03	158
MENS REST ROOM	2	2L 2x4 Flat Prismatic - F32T8/XL/SPX41	56	TR 24 132 UV 1HI W - 1L F32T8/XL/SPX41/HL	2	41	5250	5250	0.03	158
OPEN AREA UPSTAIRS	4	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	2	73	5250	5250	0.21	1,103
OPEN AREA UPSTAIRS	1	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W - 1L F32T8/XL/SPX41/HL	1	41	5250	5250	0.05	252
OFFICE 1	2	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	1	73	5250	5250	0.11	551
OFFICE 2	4	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	2	73	5250	5250	0.21	1,103
OFFICE 3	2	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	1	73	5250	5250	0.11	551
OFFICE 3	1	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W - 1L F32T8/XL/SPX41/HL	1	41	5250	5250	0.05	252
OFFICE 4	2	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	1	73	5250	5250	0.11	551
CASH OFFICE	2	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	1	73	5250	5250	0.11	551
STORAGE CLOSET	1	3L 2x4 Parabolic - F32T8/XL/SPX41	89	TR 24 132 UV 1HI W - 1L F32T8/XL/SPX41/HL	1	41	5250	5250	0.05	252
HALL / OFFICE 1 & 2	0	2X2 2L U-Bend	82	TR W9 22 217 UV 1HI W - 2x2 Troffer, (2) F17T8/XL/SPX41, (1) GE-232-MAX-H/ULTRA, White Reflector	0	38				
STAIRS	4	2L Fixture - F32T8/XL/SPX41	56	VL 132 UV 1HI - Wall Mount Fixture, (1) F32T8/XL/SPX41/HL, (1) GE-232-MAX-H/ULTRA	4	41	5250	5250	0.06	315
STOCK RM / RECVG (retrofit)	0	1L 4' Strip - F32T8/XL/SPX41	33	SR 132 UV 1HI - 1L F32T8/XL/SPX41/HL	0	41				
STOCK RM / RECVG (retrofit)	0	2L 4' Strip - F32T8/XL/SPX41	56	SR 132 UV 1HI - 1L F32T8/XL/SPX41/HL	0	41				
STOCK RM / RECVG (retrofit)	0	2L 8' Strip - F32T8/XL/SPX41	56	SRT 132 UV 1HI - 2L F32T8/XL/SPX41/HL	0	73				
STOCK RM / RECVG (retrofit)	6	4L 8' Strip - F32T8/XL/SPX41	110	SRT 132 UV 1HI - 2L F32T8/XL/SPX41/HL (retrofit to incl Occ Sensors)	6	73	5250	5250	0.22	1,166
STOCK RM / RECVG (disconnect)	0	1L 4' Strip - F32T8/XL/SPX41	33	Disconnect / De-energize	0	0				
STOCK RM / RECVG (disconnect)	0	2L 4' Strip - F32T8/XL/SPX41	56	Disconnect / De-energize	0	0				
STOCK RM / RECVG (disconnect)	0	2L 8' Strip - F32T8/XL/SPX41	56	Disconnect / De-energize	0	0				
STOCK RM / RECVG (disconnect)	5	4L 8' Strip - F32T8/XL/SPX41	110	Disconnect / De-energize	5	0	5250	5250	0.55	2,888
STOCK RM / RECVG (new)	0	1L 4' Strip - F32T8/XL/SPX41	33	S 132 UV 1HI OS WG - 4' Strip Fixture, (1) F32T8/XL/SPX41/HL Occ Sensor, Wire Guard	0	41				
STOCK RM / RECVG (new)	5	2L 4' Strip - F32T8/XL/SPX41	56	S 132 UV 1HI OS WG - 4' Strip Fixture, (1) F32T8/XL/SPX41/HL Occ Sensor, Wire Guard	5	41	5250	5250	0.08	394
STOCK RM / RECVG (new)	0	2L 8' Strip - F32T8/XL/SPX41	56	ST 132 UV 1HI OS WG - 8' Strip Fixture, (2) F32T8/XL/SPX41/HL Occ Sensor, Wire Guard	0	73				

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Table 3. Findings of the EM&V On-Site Audits for Site #1

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
STOCK RM / RECV'G (new)	29	4L 8' Strip - F32T8/XL/SPX41	110	ST 132 UV 1HI OS WG - 8' Strip Fixture, (2) F32T8/XL/SPX41/HLOcc Sensor, Wire Guard	29	73	5250	5250	1.07	5,633
STOCK RM / RECV'G: ELECTRICAL RM	1	4L 8' Strip - F32T8/XL/SPX41	110	2L 8' Strip - F32T8/XL/SPX41/HL, GE-232/MAX-H/ULTRA	1	73	5250	5250	0.04	194
STOCK RM / RECV'G: STORAGE RM	2	2L 4' Strip - F32T8/XL/SPX41	56	1L 4' Strip - F32T8/XL/SPX41/HL, GE-232/MAX-H/ULTRA	2	41	5250	5250	0.03	158
OPEN AREA UPSTAIRS	2	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	73	CI-355 Ceiling Mount	2	73	5600	4690	0.02	133
OPEN AREA UPSTAIRS	1	TR 24 132 UV 1HI W - 1L F32T8/XL/SPX41/HL	41	CI-355 Ceiling Mount	1	41	5600	4690	0.01	37
OFFICE 1	1	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	73	CI-355 Ceiling Mount	1	73	5600	4690	0.01	66
OFFICE 2	2	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	73	CI-355 Ceiling Mount	2	73	5600	4690	0.02	133
OFFICE 3	1	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	73	CI-355 Ceiling Mount	1	73	5600	4690	0.01	66
OFFICE 3	1	TR 24 132 UV 1HI W - 1L F32T8/XL/SPX41/HL	41	CI-355 Ceiling Mount	1	41	5600	4690	0.01	37
OFFICE 4	1	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	73	CI-355 Ceiling Mount	1	73	5600	4690	0.01	66
CASH OFFICE	1	TR 24 132 UV 1HI W M-2L & TR 24 132 W (wire 2 adjacent fixtures with 1 ballast) 2L F32T8/XL/SPX41/HL	73	CI-355 Ceiling Mount	1	73	5600	4690	0.01	66
STOCK RM / RECV'G (retrofit)	6	SRT 132 UV 1HI - 2L F32T8/XL/SPX41/HL (retrofit to incl Occ Sensors)	73	HB-350 Fixture Mount	6	73	5600	4690	0.07	399
STOCK RM / RECV'G (new)	5	S 132 UV 1HI OS WG - 4' Strip Fixture, (1) F32T8/XL/SPX41/HLOcc Sensor, Wire Guard	41	HB-350 Fixture Mount	5	41	5600	4690	0.03	187
STOCK RM / RECV'G (new)	29	ST 132 UV 1HI OS WG - 8' Strip Fixture, (2) F32T8/XL/SPX41/HLOcc Sensor, Wire Guard	73	HB-350 Fixture Mount	29	73	5600	4690	0.34	1,926
Total									22.56	118,654

Data Collection

Fixture Wattage and hours of operation are based on the rebate application and on-site audit information collected at Site #1. Lighting logger data were collected for representative lighting fixtures as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #1

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Motion sensor area_date range.log	5600	4690

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #1: (Retrofit Cost \$41,448 - Rebate \$15,064) / (Energy Savings \$13,052) = Simple Payback 2.02 Years.

Appendix D-2: Lighting Rebate Site #2

EM&V REPORT FOR LIGHTING SITE #2

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #2
Site Name: Site #2
Site Address: 180 North Sunrise Avenue, Roseville, CA 95661
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #2

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #2	n/a	Lighting	Roseville	Comm. Lighting	30,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #2	Lighting	171.11	856,405	n/a	65,100

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Net Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #2	Lighting	211.18	1,331,714	n/a	227,475

Spillover

No evidence of spillover was found.

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #2. The Roseville Electric rebates are provided in Table 1. For 1,109 reported measures the total rebate was \$65,100. The EM&V findings are based on installed fixtures including lamps and ballasts. The program tracks quantities of measures rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #2

Measure	Description	Qty.	Location
1	Custom Remove 458W MH	739	Retail Sales Floor
2	Custom 370W MH Elec.Ballast	370	Retail Sales Floor
Total		1,109	

Verified Efficiency Improvement: Based on site inspections, the following energy efficiency improvements were made under this project at Site #2.

Table 2. Verified Efficiency Improvements at Site #2

Measure	Description	Qty.	Location
1	Custom Remove 458W MH	739	Retail Sales Floor
2	Custom 370W MH Elec.Ballast	370	Retail Sales Floor
Total		1,109	

Primary Business Descriptions: Site #2 consists of retail sales space.

Variability in Schedule and Production: Discussions were held with personnel at the building to determine pre-existing lighting hours of use. Lighting loggers were installed at representative locations in the facility to determine ex post operational hours. These hours are reflected in the lighting surveys for the pre-installation and as-built conditions for each building.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V on-site audit for site #2 are provided in **Table 3**.

Table 3. Findings of the EM&V On-Site Audits for Site #2

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/yr Savings
Retail Sales Floor	739	400W MH (458W)	458	Removed 400W MH (458W)	0	0	6306	6306	338.46	2,134,341
Retail Sales Floor	0	320W MH Elec. Ballast	344	320W MH Elec. Ballast	370	344	6306	6306	-127.28	-802,628
Total	739				370				211.18	1,331,714

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Data Collection

Fixture Wattage and hours of operation are based on the rebate application and on-site audit information collected at Site #2. Lighting logger data were collected for representative lighting fixtures as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #2

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Retail Sales Floor	6306	6306

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #22: (Retrofit Cost \$227,475 - Rebate \$65,100) / (Energy Savings \$146,489) = Simple Payback 1.11 Years.

Appendix D-3: Lighting Rebate Site #3

M&V REPORT FOR LIGHTING SITE #3

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #3
Site Name: Site #3
Site Address: 1751 Morning Star Drive, Roseville, CA 95747
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #3

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #3	n/a	Lighting	Roseville	Comm. Lighting	45,000	Rebate

MEASURES FOR EACH PROJECT

Ex Ante Savings Estimate

Item No.	Efficiency Measure	(kW)	(kWh/yr)	(therms)	Rebate (\$)
Site #3	Lighting	1.096	9,519	n/a	4,980

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

EM&V Evaluation Gross Savings

Item No.	Efficiency Measure	(kW)	(kWh/yr)	(therms)	Cost (\$)
Site #3	Lighting	4.29	15,330	n/a	4,980

Spillover

No evidence of spillover was found.

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Impact Evaluation Report: Roseville Electric

End Use: LIGHTING

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #3. The Roseville Electric rebates are provided in Table 1. For 28 reported measures the total rebate was \$4,980.

Table 1. Planned Efficiency Improvements at Site #3

Measure	Description	Qty.	Location
1	Interior HO T-5 Fixture \$250	16	School Gym
2	Occ Sens: Integrated-\$40	12	School Gym
Total		28	

Verified Efficiency Improvement: According to the rebate application, the following energy efficiency improvements were installed at Site #3.

Table 2. Verified Efficiency Improvements at Site #3

Measure	Description	Qty.	Location
1	Interior HO T-5 Fixture \$250	16	School Gym
2	Occ Sens: Integrated-\$40	12	School Gym
Total		28	

Primary Business Descriptions: Site #3 consists of classrooms and gymnasium space.

Variability in Schedule and Production: The EM&V study evaluated the rebate application information to determine pre-existing and ex-post lighting operational hours.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

EM&V findings for site #3 are provided in **Table 3**.

Table 3. EM&V Findings for Site #3

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
School Gym	16	400W MH No Sensors	458	T5 F32 4Lx4 ft HiBay No Sensors	16	234	3577	3577	3.58	12,820
School Gym	12	T5 HiBay No Sensors	234	T5 F32 4Lx4 ft HiBay w/Occ. Sensors	12	234	3577	2683	0.70	2,510
Total	28				28				4.29	15,330

Data Collection

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Fixture Wattage and hours of operation are based on the rebate application and audit information collected at another site in the same school district. Lighting logger data were collected for representative lighting fixtures as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #3

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Classroom 3 light logger data.log	1,865	NA
Motion sensor area_date range.log	3,577	2,683

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh).

- Site #3: (Retrofit Cost \$4,980 - Rebate \$4,980) / (Energy Savings \$1,686) = Simple Payback 0.3 Years.

Appendix D-4: Lighting Rebate Site #4

M&V REPORT FOR LIGHTING SITE #4

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #4
Site Name: Site #4
Site Address: 2271 Americana Dr., Roseville, CA 95747
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #4

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #4	n/a	Lighting	Roseville	Comm. Lighting	50,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #4	Lighting	5.534	47,218	n/a	13,688

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #4	Lighting	22.85	49,948	n/a	32,202

Spillover

No evidence of spillover was found.

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #4. The Roseville Electric rebates are provided in Table 1. For 878 reported measures the total rebate was \$4,980. The EM&V findings are based on installed fixtures including lamps and ballasts. The program tracks quantities of measures rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #4

Measure	Description	Qty.	Location
1	Interior HO T-5 Fixture \$250	16	School Gym
2	Occ Sens: Integrated-\$40	12	School Gym
3	T12 to 4ft HP T8 Sys \$10	614	Classrooms
4	4-Foot T12 Delamp \$13	236	Classrooms
Total		878	

Verified Efficiency Improvement: Based on site inspections, the following energy efficiency improvements were made under this project at Site #4.

Table 2. Verified Efficiency Improvements at Site #4

Measure	Description	Qty.	Location
1	Interior HO T-5 Fixture \$250	16	School Gym
2	Occ Sens: Integrated-\$40	12	School Gym
3	T12 to 4ft HP T8 Sys \$10	614	Classrooms
4	4-Foot T12 Delamp \$13	236	Classrooms
Total		878	

Primary Business Descriptions: Site #4 consists of classrooms and gymnasium space.

Variability in Schedule and Production: Discussions were held with personnel at the building to determine pre-existing lighting hours of use. Lighting loggers were installed at representative locations in the facility to determine ex post operational hours. These hours are reflected in the lighting surveys for the pre-installation and as-built conditions for each building.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V on-site audit for site #4 are provided in **Table 3**.

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Table 3. Findings of the EM&V On-Site Audits for Site #4

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
#34	9	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	9	54	1865	1865	0.61	1,141
#33	8	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	8	54	1865	1865	0.54	1,015
#32	9	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	9	54	1865	1865	0.61	1,141
#31	9	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	9	54	1865	1865	0.61	1,141
#30	9	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	9	54	1865	1865	0.61	1,141
#10	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#11	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#9	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#12	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#8	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#14	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#8	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#14	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#4	26	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	26	52	1865	1865	0.78	1,455
#5	26	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	26	52	1865	1865	0.78	1,455
Workroom	6	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	6	52	1865	1865	0.18	336
#6	26	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	26	52	1865	1865	0.78	1,455
Workroom 1	5	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	5	52	1865	1865	0.15	280
#1	26	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	26	52	1865	1865	0.78	1,455
#2	26	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	26	52	1865	1865	0.78	1,455
#3	26	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	26	52	1865	1865	0.78	1,455
Add #3	0	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	0	52	1865	1865	0.00	0
Add #5	0	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	0	52	1865	1865	0.00	0
Add #6	0	T12 F40 (2Lx4 ft)	82	T8 F32 (2Lx4 ft)	0	52	1865	1865	0.00	0
Gym	16	400W MH No Sensors	458	T5 F32 4Lx4 ft HiBay No Sensors	16	234	3577	3577	3.58	12,820
Gym	12	T5 HiBay No. Sensors	234	T5 F32 4Lx4 ft HiBay w/Occ. Sensors	12	234	3577	2683	0.70	2,510
Total	335				335				22.85	49,948

Data Collection

Lighting logger data were collected for representative lighting fixtures as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #4

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Classroom 3 light logger data.log	1,865	NA
Motion sensor area_date range.log	3,577	2,683

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #4: (Retrofit Cost \$32,202 - Rebate \$13,688) / (Energy Savings \$5,494) = Simple Payback 3.37 Years.

Appendix D-5: Lighting Rebate Site #5

M&V REPORT FOR LIGHTING SITE #5

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #5
Site Name: Site #5
Site Address: 1250 Canevari Drive, Roseville, CA 95747
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #5

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #5	n/a	Lighting	Roseville	Comm. Lighting	40,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #5	Lighting	4.504	38,959	n/a	10,302

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #5	Lighting	17.73	40,400	n/a	14,543

Spillover

No evidence of spillover was found.

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Impact Evaluation Report: Roseville Electric

End Use: LIGHTING

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #5. The Roseville Electric rebates are provided in Table 1. For 540 reported measures the total rebate was \$10,302.

Table 1. Planned Efficiency Improvements at Site #5

Measure	Description	Qty.	Location
1	T12 to 4ft HP T8 Sys \$10	278	Classrooms
2	4-Foot T12 Delamp \$13	234	Classrooms
3	Interior HO T-5 Fixture \$250	16	School Gym
4	Occ Sens: Integrated-\$40	12	School Gym
Total		540	

Verified Efficiency Improvement: According to the rebate application, the following energy efficiency improvements were installed at Site #5.

Table 2. Verified Efficiency Improvements at Site #5

Measure	Description	Qty.	Location
1	T12 to 4ft HP T8 Sys \$10	278	Classrooms
2	4-Foot T12 Delamp \$13	234	Classrooms
3	Interior HO T-5 Fixture \$250	16	School Gym
4	Occ Sens: Integrated-\$40	12	School Gym
Total		540	

Primary Business Descriptions: Site #5 consists of classrooms and gymnasium space.

Variability in Schedule and Production: The EM&V study evaluated the rebate application information to determine pre-existing and ex-post lighting operational hours.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

EM&V findings for site #5 are provided in **Table 3**.

Table 3. EM&V Findings for Site #5

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
K-4	11	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	11	54	1865	1865	1.21	2,257
#34	9	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	9	54	1865	1865	0.61	1,141
#33	8	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	8	54	1865	1865	0.54	1,015
#32	9	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	9	54	1865	1865	0.61	1,141
#31	9	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	9	54	1865	1865	0.61	1,141

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Table 3. EM&V Findings for Site #5

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
#30	9	T12 F40 (3Lx4 ft)	122	T8 F32 (2Lx4 ft)	9	54	1865	1865	0.61	1,141
#26	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#25	12	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	12	54	1865	1865	1.32	2,462
#24	10	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	10	54	1865	1865	1.10	2,052
23	10	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	10	54	1865	1865	1.10	2,052
#22	10	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	10	54	1865	1865	1.10	2,052
21	10	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	10	54	1865	1865	1.10	2,052
#20	10	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	10	54	1865	1865	1.10	2,052
#19	10	T12 F40 (4Lx4 ft)	164	T8 F32 (2Lx4 ft)	10	54	1865	1865	1.10	2,052
Gym	16	400W MH No Sensors	458	T5 F32 4Lx4 ft HiBay	16	234	3577	3577	3.58	12,820
Gym	12	T5 F32 4Lx4 ft HiBay	234	T5 F32 4Lx4 ft HiBay Sensors	12	234	3577	2683	0.70	2,510
Total	167				167				17.73	40,400

Data Collection

Fixture Wattage and hours of operation are based on the rebate application and on-site audit information collected at another site in the same school district. Lighting logger data were collected for representative lighting fixtures as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #5

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Classroom 3 light logger data.log	1,865	NA
Motion sensor area_date range.log	3,577	2,683

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #5: (Retrofit Cost \$14,543 - Rebate \$10,302) / (Energy Savings \$4,444) = Simple Payback 0.95 Years.

Appendix D-6: Lighting Rebate Site #6

EM&V REPORT FOR LIGHTING SITE #6

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #6
Site Name: Site #6
Site Address: 8000 Foothills Blvd, Roseville, CA 95747
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #6

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #6	n/a	Lighting	Roseville	Comm. Lighting	500,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #6	Lighting	78.03	282,569	n/a	100,165

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #6	Lighting	122.68	703,985	n/a	423,106

Spillover

No evidence of spillover was found.

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #6. The Roseville Electric rebates are provided in Table 1. For 10,369 reported measures the total rebate was \$100,165. The program tracks quantities of measures (efficient lamps or removed lamps) rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #6

Measure	Description	Qty.	Location
1	T8/T5 Lamp w/EB 2-ft \$4	16	R3 Upper
2	CFL >13 watts-\$10	4	Dining Services
3	Photocell sensor-\$44	12	R4
4	CFL 5-13 watts-\$5t	12	R4
5	High Efficiency Exit Sign-\$60	7	R4 Cafeteria
6	High Efficiency Exit Sign-\$60	12	C & D
7	T8 to RW T8 Sys Retro \$8.5	780	R4 Cafeteria
8	Custom Lighting	1	C & D
9	CFL >13 watts-\$10	171	R4 Cafeteria
10	T8 to RW T8 Sys Retro \$8.5	9,354	Dining , R3, R4, R5
Total		10,369	

Verified Efficiency Improvement: The EM&V findings are based on installed fixtures including lamps and ballasts. The EM&V on-site inspections verified 11,629 installed measures.

Table 2. Verified Efficiency Improvements at Site #6

Measure	Description	Qty.	Location
1	T8/T5 Lamp w/EB 2-ft \$4	16	R3 Upper
2	CFL >13 watts-\$10	4	Dining Services
3	Photocell sensor-\$44	0	R4
4	CFL 5-13 watts-\$5t	24	R4
5	High Efficiency Exit Sign-\$60	7	R4 Cafeteria
6	High Efficiency Exit Sign-\$60	12	C & D
7	T8 to RW T8 Sys Retro \$8.5	780	R4 Cafeteria
8	Custom Lighting	1,239	C & D
9	CFL >13 watts-\$10	171	R4 Cafeteria
10	T8 to RW T8 Sys Retro \$8.5	9,376	Dining , R3, R4, R5
Total		11,629	

Primary Business Descriptions: Site #6 consists of office, cafeteria, manufacturing, and storage space.

Variability in Schedule and Production: Discussions were held with personnel at the building to determine pre-existing lighting hours of use. Lighting loggers were installed at representative locations in the facility to determine ex post operational hours. These hours are reflected in the lighting surveys for the pre-installation and as-built conditions for each building.

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V on-site audit for site #6 are provided in **Table 3**.

Table 3. Findings of the EM&V On-Site Audits for Site #6

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
Dining Services	1	T8 F32 EB (4Lx4 ft 8ft)	108	T8 F25 EB (4Lx4 ft tandem 8ft)	1	77	8760	8760	0.03	272
Dining Services	12	T8 F32 EB (2Lx4 ft 8ft)	61	T8 F25 EB (2Lx4 ft tandem 8ft)	12	44	8760	8760	0.20	1,787
Dining Services	88	T8 F32 EB (2Lx4 ft)	61	T8 F25 EB (2Lx4 ft)	88	44	8760	8760	1.50	13,105
Dining Services	3	T8 F32 EB (2U-Lx2 ft)	56	T8 F17 EB (2U-Lx2 ft)	3	35	8760	8760	0.06	552
Dining Services	1	T8 F32 EB (2U-Lx2 ft)	56	T8 F17 EB (2U-Lx2 ft)	1	35	8760	8760	0.02	184
Dining Services	4	100W Incand.	100	23W CFL	4	23	8760	8760	0.31	2,698
R3 Lower	899	T8 F32 (EB 3Lx4 ft)	88	T8 F25 EB (3Lx4 ft)	899	58	6268	6268	26.97	169,048
R3 Lower	140	T8 F32 EB (2Lx4 ft 8ft)	61	T8 F25 EB (2Lx4 ft)	140	44	6268	6268	2.38	14,918
R3 Upper	37	T8 F25 EB (2Lx4 ft)	61	T8 F25 EB (2Lx4 ft)	37	44	4427	4427	0.63	2,785
R3 Upper	697	T8 F32 EB (3Lx4 ft)	88	T8 F25 EB (3Lx4 ft)	697	58	4427	4427	20.91	92,569
R3 Upper	8	T8 F32 EB (2U-Lx2 ft)	56	T8 F17 EB (2U-Lx2 ft)	8	35	4427	4427	0.17	744
R4	1146	T8 F32 EB (1Lx4 ft)	39	T8 F25 EB (1Lx4 ft)	1146	33	3830	3830	6.88	26,335
R4	214	T8 F25 EB (2Lx4 ft)	61	T8 F25 EB (2Lx4 ft)	214	44	3830	3830	3.64	13,934
R4	12	60W Recessed Can	60	13W Recessed Can	12	13	3830	3830	0.56	2,160
R4	12	No Sensors	60	Dimming Sensor Controls	12	34	5107	3830	0.41	2,114
R5 Lower	758	T8 F25 EB (2Lx4 ft)	61	T8 F25 EB (2Lx4 ft)	758	44	4274	4274	12.89	55,075
C & D	12	Incand. Exit Sign	40	LED Exit Sign	12	3	8760	8760	0.44	3,889
C	153	T8 F32 (EB 3Lx4 ft)	88	T8 F25 EB (2Lx4 ft)	153	44	3830	3830	6.73	25,784
D	260	T8 F32 (EB 3Lx4 ft)	88	T8 F25 EB (2Lx4 ft)	260	44	3830	3830	11.44	43,815
R4 Cafeteria	7	Incand. Exit Sign	40	LED Exit Sign	7	3	8760	8760	0.26	2,269
R4 Cafeteria	171	75W R30	75	CF15/R30/27-43	171	15	8760	8760	10.26	89,878
R4 Cafeteria	390	T8 F32 (EB 3Lx4 ft)	88	T8 F25 EB (2Lx4 ft)	390	47	8760	8760	15.99	140,072
Total	5025	0	0	0	5025	0	0	0	122.68	703,985

Data Collection

Fixture Wattage and hours of operation are based on the Roseville Electric rebate application and on-site audit information collected at Site #6. Lighting logger data were collected for representative lighting fixtures as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #6

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
R3 lower light logger data.log	6,268	NA
R3 upper light logger data.log	4,427	NA
R4 light logger data.log	5,107	3,830
R5 light logger data.log	4,274	NA
Dining/kitchen light logger data.log	8,760	NA

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #6: (Retrofit Cost \$423,106 - Rebate \$100,165) / (Energy Savings \$77,438) = Simple Payback 4.17 Years.

Appendix D-7: Lighting Rebate Site #7

M&V REPORT FOR LIGHTING SITE #7

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #7
Site Name: Site #7
Site Address: 1950 Johnson Ranch Rd., Roseville, CA 95661
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #7

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #7	n/a	Lighting	Roseville	Comm. Lighting	40,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			
		(kW)	(kWh/yr)	(therms)	Rebate (\$)
Site #7	Lighting	17.34	62,639	n/a	14,564

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			
		(kW)	(kWh/yr)	(therms)	Cost (\$)
Site #7	Lighting	25.52	45,342	n/a	60,280

Spillover

No evidence of spillover was found.

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #7. The Roseville Electric rebates are provided in Table 1. For 2,306 reported measures the total rebate was \$14,564. The EM&V findings are based on installed fixtures including lamps and ballasts. The program tracks quantities of measures rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #7

Measure	Description	Qty.	Location
1	T8/T5 Lamp w/EB 4-ft-8.50	516	Classrooms
2	T8/T5 Lamp w/EB 3-ft-\$6.50	48	Classrooms
3	4-Foot T12 Delamp \$12	20	Classrooms
4	Custom Lighting	1,722	Classrooms
Total		2,306	

Verified Efficiency Improvement: The EM&V findings are based on installed fixtures including lamps and ballasts. The EM&V on-site inspections verified 2,314 installed measures.

Table 2. Verified Efficiency Improvements at Site #7

Measure	Description	Qty.	Location
1	T8/T5 Lamp w/EB 4-ft-8.50	524	Classrooms
2	T8/T5 Lamp w/EB 3-ft-\$6.50	48	Classrooms
3	4-Foot T12 Delamp \$12	20	Classrooms
4	Custom Lighting	1,722	Classrooms
Total		2,314	

Primary Business Descriptions: Site #7 consists of classrooms.

Variability in Schedule and Production: Discussions were held with personnel at the building to determine pre-existing lighting hours of use. Lighting loggers were installed at representative locations in the facility to determine ex post operational hours. These hours are reflected in the lighting surveys for the pre-installation and as-built conditions for each building.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V on-site audit for site #7 are provided in **Table 3**. Fixture quantities are different since the rebate is based on lamp quantities.

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Table 3. Findings of the EM&V On-Site Audits for Site #7

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
Custom	156	T8 F32 SB, SL (2Lx4 ft)	59	T8 F32 (2Lx4 ft)	156	42	1777	1777	2.65	4,713
Custom	612	T8 F32 SB, SL (2Lx4 ft)	59	T8 F32 (2Lx4 ft)	612	42	1777	1777	10.40	18,488
Custom	42	T8 F32 SB, SL (3Lx4 ft)	88	T8 F32 (2Lx4 ft)	42	42	1777	1777	1.93	3,433
Custom	20	T8 F32 SB, SL (3Lx4 ft)	88	T8 F32 (2Lx4 ft)	20	42	1777	1777	0.92	1,635
Prescriptive	112	T12 F34 ES (2Lx4 ft)	74	T8 F32 (2Lx4 ft)	112	42	1777	1777	3.58	6,369
Prescriptive	36	T12 F34 ES (2Lx4 ft)	74	T8 F32 (2Lx4 ft)	36	42	1777	1777	1.15	2,047
Prescriptive	3	T12 F34 ES (2Lx4 ft)	74	T8 F32 (2Lx4 ft)	3	42	1777	1777	0.10	171
Prescriptive	12	T12 F34 ES (3Lx4 ft)	108	T8 F32 (2Lx4 ft)	12	42	1777	1777	0.79	1,407
Prescriptive	8	T12 F34 ES (3Lx4 ft)	108	T8 F32 (2Lx4 ft)	8	42	1777	1777	0.53	938
Prescriptive	24	T12 F34 ES (2Lx3 ft)	66	T8 F32 (2Lx3 ft)	24	38	1777	1777	0.67	1,194
Prescriptive	39	T12 F34 ES (2Lx4 ft)	74	T8 F32 (2Lx4 ft)	39	42	1777	1777	1.25	2,218
Prescriptive	48	T12 F34 ES (2Lx4 ft)	74	T8 F32 (2Lx4 ft)	48	42	1777	1777	1.54	2,729
Total	1,112				1,112				25.52	45,342

Data Collection

Fixture Wattage and hours of operation are based on the Roseville Electric rebate application and on-site audit information collected at Site #7. Lighting logger data were collected for representative lighting fixtures at Site #7 as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #7

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Classroom_light_logger_data.log	1,777	NA

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh).

- Site #7: (Retrofit Cost \$60,280 - Rebate \$14,564) / (Energy Savings \$4,988) = Simple Payback 9.71 Years.

Appendix D-8: Lighting Rebate Site #8

M&V REPORT FOR LIGHTING SITE #8

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #8
Site Name: Site #8
Site Address: 1 Tiger Way and 2511 Woodcreek Oaks, Roseville, CA
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #8

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #8	n/a	Lighting	Roseville	Comm. Lighting	10,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			
		(kW)	(kWh/yr)	(therms)	Rebate (\$)
Site #8	Lighting	1.078	9,355	n/a	3,596

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			
		(kW)	(kWh/yr)	(therms)	Cost (\$)
Site #8	Lighting	3.923	7,590	n/a	7,150

Spillover

No evidence of spillover was found.

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Impact Evaluation Report: Roseville Electric

End Use: LIGHTING

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #8. The Roseville Electric rebates are provided in Table 1. For 61 reported measures the total rebate was \$3,596.

Table 1. Planned Efficiency Improvements at Site #8

Measure	Description	Qty.	Location
1	Interior HO T-5 Fixture \$250	12	Garage
2	4-Foot T12 Delamp \$13	24	Garage
3	T12 to 4ft HP T8 Sys \$10	24	Gym
4	OccSens:Wall/Ceiling-\$44	1	Gym
Total		61	

Verified Efficiency Improvement: According to the rebate application, the following energy efficiency improvements were installed at Site #8.

Table 2. Verified Efficiency Improvements at Site #8

Measure	Description	Qty.	Location
1	Interior HO T-5 Fixture \$250	12	Garage
2	4-Foot T12 Delamp \$13	24	Garage
3	T12 to 4ft HP T8 Sys \$10	24	Gym
4	OccSens:Wall/Ceiling-\$44	1	Gym
Total		61	

Primary Business Descriptions: Site #8 consists of garage and classroom space.

Variability in Schedule and Production: The EM&V study reviewed the rebate application to determine lighting hours of use.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation. The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

EM&V findings based on review of the rebate application for site #8 are provided in **Table 3**.

Table 3. Findings of the EM&V for Site #8

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
Business Garage	12	400W MH	458	T5HO (4Lx4 ft) SS-QHE2X54	12	220	2000	2000	2.86	5,712
Business Garage	2	None	0	T8 F32 (2Lx4 ft)	2	107	2000	2000	-0.21	-428
School	24	T12 F40 2Lx4 ft	74	T8 F32 (2Lx4 ft) No Sensor	12	55	1800	1800	1.12	2,009
School	12	T8 F32 2Lx4 ft No Sensor	55	T8 F32 2Lx4 ft Occupancy Sensor	12	55	1800	1350	0.17	297
Total	50				38				3.92	7,590

Data Collection

Fixture Wattage and hours of operation are based on the Roseville Electric rebate application.

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #8: (Retrofit Cost \$7,150 - Rebate \$3,596) / (Energy Savings \$835) = Simple Payback 4.26 Years.

Appendix D-9: Lighting Rebate Site #9

M&V REPORT FOR LIGHTING SITE #9

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #9

Site Name: Site #9

Site Address: 1600 Eureka Blvd., Roseville, CA 95661

Principal Site Contact Name: N/A **Telephone:** N/A

Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671

Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #9

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #9	n/a	Lighting	Roseville	Comm. Lighting	300,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #9	Lighting	79.6	658,130	n/a	57,324

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #9	Lighting	78.9	654,412	n/a	138,288

Spillover

No evidence of spillover was found.

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #9. The Roseville Electric rebates are provided in Table 1. For 448 reported measures the total rebate was \$57,324. Custom lighting was reported as 1 measure instead of 779 measures. The EM&V findings are based on installed fixtures including lamps and ballasts. The program tracks quantities of measures rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #9

Measure	Description	Qty.	Location
1	OccSens:Wallbox-\$40	25	MOB1
2	OccSens:Wallbox-\$41	422	MOB1
3	Custom Lighting	1	Parking/Elevator/etc.
Total		448	

Verified Efficiency Improvement: The EM&V findings are based on installed fixtures including lamps and ballasts. The study verified 1,226 installed measures (lamps installed and removed).

Table 2. Verified Efficiency Improvements at Site #9

Measure	Description	Qty.	Location
1	OccSens:Wallbox-\$40	25	MOB1
2	OccSens:Wallbox-\$41	422	MOB1
3	Custom Lighting	779	Parking/Elevator/etc.
Total		1226	

Primary Business Descriptions: Site #9 consists of garage and classroom space.

Variability in Schedule and Production: The EM&V study reviewed the rebate application to determine lighting hours of use.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V study review of the rebate application for site #9 are provided in **Table 3**.

Table 3. Findings of the EM&V On-Site Audits for Site #9

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
Elevators (Ele)	8	1x4, 2-Lamp	69.5	Elect. LPPS Bal. & (2) 4' 25W T8's	8	38	8760	8760	0.25	2,208
Elev Lob 1b (G-P1)	2	1x4, 2-Lamp T8	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Elev Lob 1b (G-P1)	12	1x4, 2-Lamp T8	58	(2) 4' T8 25W	12	44	8760	8760	0.17	1,472
Elev Lobby 1 (G-P1)	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736
Elev Mach 2 (G-P1)	2	1x4, 2-Lamp T8	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Elev Lobby 2 (G-P2)	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Table 3. Findings of the EM&V On-Site Audits for Site #9

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
Eng Room (G-P2)	2	1x4, 2-Lamp T8	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Security Tele (G-P2)	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736
Telecom (G-P2)	2	1x4, 2-Lamp T8	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Elev Lob 2b (G-P2)	7	1x4, 2-Lamp T8	58	(2) 4' T8 25W	7	44	8760	8760	0.10	858
Exterior (G-P2)	4	1x4, 2-Lamp T8	58	(2) 4' T8 25W	4	44	8760	8760	0.06	491
Elev Lob 3b (G-P3)	7	1x4, 2-Lamp T8	58	(2) 4' T8 25W	7	44	8760	8760	0.10	858
Elev Lobby 3 (G-P3)	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736
Elec Closet (G-P3)	1	1x4, 2-Lamp T8	58	(2) 4' T8 25W	1	44	8760	8760	0.01	123
Elev Lobby 4 (G-P4)	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736
Elev Lob 4b (G-P4)	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736
Elev Lob 5b (G-P5)	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736
Elev Lobby 5 (G-P5)	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736
Stairs	6	1x4, 2-Lamp T8	58	(2) 4' T8 25W	6	38	8760	8760	0.12	1,051
Main Electrical (G-1)	6	1x8, 2-Lamp	123	Elec.LP Bal (4) 4' 25W T8, 8ft Retrofit	6	73	8760	8760	0.30	2,628
Stair 1 (G-P3)	2	1x8, 2-Lamp T8 4'	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Stair 1 (G-P4)	2	1x8, 2-Lamp T8 4'	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Stair 1 (G-P5)	2	1x8, 2-Lamp T8 4'	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Lost & Found (G-P3)	2	2x4, 2-Lamp T8	58	(2) 4' T8 25W (one missing fixture)	1	44	8760	8760	0.07	631
Security (G-P3)	2	2x4, 2-Lamp T8	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Office (G-P3)	2	2x4, 2-Lamp T8	58	(2) 4' T8 25W	2	44	8760	8760	0.03	245
Open (G-P3)	6	2x4, 2-Lamp T8	58	(2) 4' T8 25W	6	44	8760	8760	0.08	736
Restroom (G-P3)	1	2x4, 2-Lamp T8	58	(2) 4' T8 25W	1	44	8760	8760	0.01	123
Main Parking (G-P5)	72	MH 150w	185	New 1x4 Stair NP Bal (2) 4' 25w T8	72	48	8760	8760	9.86	86,409
Main Park 4 (G-P4)	97	MH 150w	185	New 1x4 Stair NP Bal (2) 4' 25w T8's	97	48	8760	8760	13.29	116,412
Main Park 3 (G-P3)	93	MH 150w	185	New 1x4 Stair NP Bal & (2) 4' 25w T8	93	48	8760	8760	12.74	111,611
Main Park 2 (G-P2)	103	MH 150w	185	New 1x4 Stair NP Bal (2) 4' 25w T8's	103	48	8760	8760	14.11	123,612
Main Park 1 (G-P1)	54	MH 150w	185	New 1x4 Stair NP Bal (2) 4' 25w T8	54	48	8760	8760	7.40	64,806
Main Park 1st ()	6	MH 150w	185	New 1x4 Stair NP Bal.(2) 4' 25w T8's	6	38	8760	8760	0.88	7,726
Landing (G-P5)	32	MH 70w	95	Compact One Piece 42w	32	42	8760	8760	1.70	14,857
Landing (G-P4)	32	MH 70w	95	Compact One Piece 42w	32	42	8760	8760	1.70	14,857
Landing (G-P3)	32	MH 70w	95	Compact One Piece 42w	32	42	8760	8760	1.70	14,857
Elev Lobby 1 (G-P1)	6	MH 70w	95	Compact One Piece 42w	6	42	8760	8760	0.32	2,786
MOB1	447	No Occ. Sensors	44	Occupancy Sensors	447	44	5935	2010	13.01	77,206
Total	1100				1099	44.6			78.90	654,412

Data Collection

Fixture Wattage and hours of operation are based on the Roseville Electric rebate application and audit information collected at Site #9. Elevator, parking, lobby, and office areas operate 24 hours per day and seven days per week. Lighting logger data were collected for representative lighting fixtures in MOB1 as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #9

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
MOB1 motion sensor light_logger_data.log	5,935	2,010

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #9: (Retrofit Cost \$138,288 - Rebate \$57,324) / (Energy Savings \$71,985) = Simple Payback 1.12 Years.

Appendix D-10: Lighting Rebate Site #10

M&V REPORT FOR LIGHTING SITE #10

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #10
Site Name: Site #10
Site Address: 10101 Foothills Blvd., Roseville, CA 95747
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #10

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #10	n/a	Lighting	Roseville	Comm. Lighting	88,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #10	Lighting	52.6	170,576	n/a	28,429

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #10	Lighting	54.66	376,889	n/a	58,032

Spillover

No evidence of spillover was found.

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #10. The Roseville Electric rebates are provided in Table 1. For 2,182 reported measures the total rebate was \$28,429. The EM&V findings are based on installed fixtures including lamps and ballasts. The program tracks quantities of measures rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #10

Measure	Description	Qty.	Location
1	Interior HO T-5 Fixture \$250	10	Phase 6
2	Custom Lighting	1	Phase 1, 2, 3
3	T8/T5 Lamp w/EB 8-ft \$15	61	Phase 1, 6
4	CFI > 13 watts \$10	14	Phase 4
5	OccSens:Wallbox-\$40	31	Phase 1, 3, 4, 6
6	Occ Sens: Integrated-\$40	35	Phase 1, 6
7	8 Foot T12 Delamp	57	Phase 1, 6
8	T8/T5 Lamp w/EB 4-ft-8.50	1318	Phase 2, 3, 4
9	4-Foot T12 Delamp \$12	655	Phase 2, 3, 4
Total		2,182	

Verified Efficiency Improvement: The EM&V findings are based on installed fixtures including lamps and ballasts. The study verified 2,251 installed measures (lamps installed and removed).

Table 2. Verified Efficiency Improvements at Site #10

Measure	Description	Qty.	Location
1	Interior HO T-5 Fixture \$250	60	Phase 6
2	Custom Lighting	20	Phase 1, 2, 3
3	T8/T5 Lamp w/EB 8-ft \$15	61	Phase 1, 6
4	CFI > 13 watts \$10	14	Phase 4
5	OccSens:Wallbox-\$40	31	Phase 1, 3, 4, 6
6	Occ Sens: Integrated-\$40	35	Phase 1, 6
7	8 Foot T12 Delamp	57	Phase 1, 6
8	T8/T5 Lamp w/EB 4-ft-8.50	1318	Phase 2, 3, 4
9	4-Foot T12 Delamp \$12	655	Phase 2, 3, 4
Total		2,251	

Primary Business Descriptions: Site #10 consists of garage and classroom space.

Variability in Schedule and Production: The EM&V study reviewed the rebate application to determine lighting hours of use.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Findings of the EM&V study review of the rebate application for site #10 are provided in **Table 3**.

Table 3. Findings of the EM&V On-Site Audits for Site #10

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
Ph 1 - Warehouse	6	T12 F96 EB (2Lx8 ft)	142	T8 F32 EB (4Lx4 ft tandem 8ft)	6	108	8473	8473	0.20	1,728
Ph 1 - Warehouse	4	T12 F96 EB (2Lx8 ft)	142	Removed (Delamped)	4	0	8473	8473	0.57	4,813
Ph 1 - Warehouse	25	250W MH w/o sensors	290	T8 F32 EB (4Lx4 ft HiBay) w/o sens	25	147	8473	8473	3.58	30,291
Ph 1 - Warehouse	25	T8 F32 EB (4Lx4 ft HiBay)	147	T8 F32 EB (4Lx4 ft HiBay) w/sensors	25	147	8760	8473	0.12	1,055
Ph 1 - Warehouse	36	T12 F96 EB (2Lx8 ft)	142	T8 F32 EB (2Lx4 ft)	36	61	8473	8473	2.92	24,707
Ph 1 - Warehouse	36	T12 F96 EB (1Lx8 ft)	71	Removed (Delamped)	36	0	8473	8473	2.56	21,657
Ph 1 - Warehouse	14	New Fixtures w/o sensors	203	New Fixtures w/ wall sensors	14	203	8760	8473	0.09	816
Ph 6 - Warehouse 3	10	400W HID w/o sensors	458	T8 F32 (6Lx4 ft HiBay) w/o sensors	10	221	8473	8473	2.37	20,081
Ph 6 - Warehouse 3	10	T8 F32 (6Lx4 ft HiBay)	221	T8 F32 EB (4Lx4 ft HiBay) w/sensors	10	221	8760	8473	0.07	634
Ph 6 - Warehouse 3	13	T12 F96 EB (1Lx8 ft)	71	T8 F32 EB (1Lx4 ft)	13	30	8473	8473	0.53	4,516
Ph 6 - Warehouse 3	13	T12 F96 EB (1Lx8 ft)	71	Removed (Delamped)	13	0	8473	8473	0.92	7,821
Ph 6 - Warehouse 3	2	New Fixtures	195	New Fixtures w/ wall sensors	2	195	8760	8473	0.01	112
Ph 2-Assy/Off Core	8	T12 F34 (2Lx4 ft)	78	T8 F32 (2Lx4 ft)	8	61	8473	8473	0.14	1,152
Ph 2 - Assy/Off Core	6	100W Incand.	100	CFL 23W	6	23	8473	8473	0.46	3,915
Ph 2 - Assy/Off Core	6	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	6	61	8473	8473	0.10	864
Ph 2 - Assy/Off Core	6	T12 F34 (2Lx4 ft)	78	Removed (Delamped)	6	0	8473	8473	0.47	3,965
Ph 2 - Assy/Off Core	302	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	302	61	8473	8473	5.13	43,500
Ph 2 - Assy/Off Core	302	T12 F34 (1Lx4 ft)	39	Removed (Delamped)	302	0	8473	8473	11.78	99,795
Ph 3 - Office/Conf	7	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	7	61	3485	3485	0.12	415
Ph 3 - Office/Conf	38	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	38	61	3485	3485	0.65	2,251
Ph 3 - Office/Conf	38	T12 F34 (1Lx4 ft)	39	Removed (Delamped)	38	0	3485	3485	1.48	5,165
Ph 3 - Office/Conf	8	T12 F34 (1Lx4 ft)	39	T8 F32 EB (1Lx4 ft)	8	30	3485	3485	0.07	251
Ph 3 - Office/Conf	8	T12 F34 (1Lx4 ft)	39	Removed (Delamped)	8	0	3485	3485	0.31	1,087
Ph 3 - Office/Conf	41	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	41	61	3485	3485	0.70	2,429
Ph 3 - Office/Conf	41	T12 F34 (1Lx4 ft)	39	Removed (Delamped)	41	0	3485	3485	1.60	5,573
Ph 3 - Office/Conf	5	100W Incand.	100	CFL 23W	5	23	3485	3485	0.39	1,342
Ph 3 - Office/Conf	5	60W Incand. Track	60	CFL 15W	5	15	3485	3485	0.23	784
Ph 3 - Office/Conf	8	New Fixtures	686	New Fixtures w/ wall sensors	8	686	4647	3485	1.37	6,377
Ph 4 - Cube Area	5	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	5	61	4940	4940	0.09	420
Ph 4 - Cube Area	227	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	227	61	4940	4940	3.86	19,063
Ph 4 - Cube Area	227	T12 F34 (1Lx4 ft)	39	Removed (Delamped)	227	0	4940	4940	8.85	43,734
Ph 4 - Cube Area	6	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	6	61	4940	4940	0.10	504
Ph 4 - Cube Area	6	T12 F34 (2Lx4 ft)	78	Removed (Delamped)	6	0	4940	4940	0.47	2,312
Ph 4 - Cube Area	5	60W Incand. Track	60	CFL 14W	5	14	4940	4940	0.23	1,136
Ph 4 - Cube Area	15	T12 F34 (2Lx4 ft)	78	T8 F32 EB (2Lx4 ft)	15	61	4940	4940	0.26	1,260
Ph 4 - Cube Area	15	T12 F34 (1Lx4 ft)	39	Removed (Delamped)	15	0	4940	4940	0.59	2,890
Ph 4 - Cube Area	7	New Fixtures w/o sensors	735	New Fixtures w/ wall sensors	7	735	6587	4940	1.29	8,474
Total	1529				1536				54.66	376,889

Data Collection

Fixture Wattage and hours of operation are based on the Roseville Electric rebate application and on-site audit information collected at Site #10. Lighting logger data were collected for representative lighting fixtures at Site #10 as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #10

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Office area 1 light logger_data.log	4647	3485
Office area 2 light logger_data.log	6587	4940
Production area light logger data.log	8473	NA

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #10: (Retrofit Cost \$58,032 - Rebate \$28,429) / (Energy Savings \$41,458) = Simple Payback 0.71 Years.

Appendix D-11: Lighting Rebate Site #11

M&V REPORT FOR LIGHTING SITE #11

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #11

Site Name: Site #11

Site Address: 10030 Foothills Blvd., Roseville, CA 95747

Principal Site Contact Name: N/A **Telephone:** N/A

Utility Representative Name: Renee Laffey **Telephone:** (916) 774-5671

Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #11

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #11	n/a	Lighting	Roseville	Comm. Lighting	100,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			
		(kW)	(kWh/yr)	(therms)	Rebate (\$)
Site #11	Lighting	7.32	32,475	n/a	34,851

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #11	Lighting	44.03	310,727	n/a	34,934

Spillover

No evidence of spillover was found.

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Impact Evaluation Report: Roseville Electric

End Use: LIGHTING

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #11. The Roseville Electric rebates are provided in Table 1. For 134 reported measures the total rebate was \$34,851. Custom lighting was reported as 1 measure instead of 263 measures. The EM&V findings are based on installed fixtures including lamps and ballasts. The program tracks quantities of measures rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #11

Measure	Description	Qty.	Location
1	Custom Lighting	1	1st Floor
2	Interior HO T-5 Fixture \$250	133	Warehouse, Mgfring
Total		134	

Verified Efficiency Improvement: The EM&V findings are based on installed fixtures including lamps and ballasts. The study verified 428 installed measures (lamps installed and removed).

Table 2. Verified Efficiency Improvements at Site #11

Measure	Description	Qty.	Location
1	Custom Lighting	263	1st Floor
2	Interior HO T-5 Fixture \$250	165	Warehouse, Mgfring
Total		428	

Primary Business Descriptions: Site #11 consists of garage and classroom space.

Variability in Schedule and Production: The EM&V study reviewed the rebate application to determine lighting hours of use.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V study review of the rebate application for site #11 are provided in **Table 3**.

Table 3. Findings of the EM&V On-Site Audits for Site #11

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
1st Floor	32	T8 F32 (3Lx4 ft)	84	T8 F32 (2Lx4 ft)	32	53	4327	4327	0.99	4,292
1st Floor	62	T8 F32 (2L-Ux4 ft)	53	T8 F17 (2Lx2 ft)	62	32	4327	4327	1.30	5,634
1st Floor	75	T8 F32 (1Lx4 ft)	28	T8 F25 (1Lx4 ft)	75	23	4327	4327	0.38	1,623
Ware, Prod, Elec	133	400W MH (458W)	458	T8 F32 (4Lx4ft HiBay)	133	147	7233	7233	41.36	299,179
Total	302		0		302	0	0	0	44.03	310,727

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Data Collection

Fixture Wattage and hours of operation are based on the Roseville Electric rebate application and on-site audit information collected at Site #11. Lighting logger data were collected for representative lighting fixtures at Site #11 as shown in **Table 4**. The hours of operation for warehouse, production, and electronics are 7,233 hours per year based on light logger data. The first floor area hours of operation are the average of the light loggers or 4,327 hours per year.

Table 4. Lighting Logger Measurements for Site #11

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Warehouse_Production_Electronics_33.log	7233	NA
Light logger 11 data_data.log	2394	NA
Light logger 31 data_data.log	3354	NA
Average of logger data	4327	NA

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #11: (Retrofit Cost \$34,934 - Rebate \$34,851) / (Energy Savings \$34,180) = Simple Payback 0 Years (immediate).

Appendix D-12: Lighting Rebate Site #12

EM&V REPORT FOR LIGHTING SITE #12

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #12

Site Name: Site #12

Site Address: 8150 Industrial Blvd., Roseville, CA 95748

Principal Site Contact Name: N/A **Telephone:** N/A

Utility Representative Name: Rennee Laffey **Telephone:** (916) 774-5671

Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #12

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #12	n/a	Lighting	Roseville	Comm. Lighting	75,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #12	Lighting	21.64	76,239	n/a	28,224

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #12	Lighting	36.69	219,523	n/a	43,467

Spillover

No evidence of spillover was found.

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Impact Evaluation Report: Roseville Electric

End Use: LIGHTING

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #12. The Roseville Electric rebates are provided in Table 1. For 2,379 reported measures the total rebate was \$28,224. The EM&V findings are based on installed fixtures including lamps and ballasts.

Table 1. Planned Efficiency Improvements at Site #12

Measure	Description	Qty.	Location
1	T12 to 4ft RW T8 Sys \$12	1,673	Bldg A-D Light Logger ave
2	4-Foot T12 Delamp \$13	3	Bldg A Light Logger data
3	T8 to RW T8 Sys Retro \$8.5	64	Bldg A Light Logger data
4	T8 to RW T8 Sys Retro \$8.5	6	Bldg B Light Logger data
5	T8 to RW T8 Sys Retro \$8.5	536	Bldg D Light Logger data
6	4-Foot T12 Delamp \$13	14	Bldg A Light Logger data
7	T8/T5 Lamp w/EB 3-ft \$6	8	Bldg A Light Logger data
8	T8/T5 Lamp w/EB 3-ft \$6	8	Bldg D Light Logger data
9	OccSens:Wallbox-\$40	67	Bldg A-D Light Logger ave
Total		2,379	

Verified Efficiency Improvement: Based on site inspections, the following energy efficiency improvements were made under this project at Site #12.

Table 2. Verified Efficiency Improvements at Site #12

Measure	Description	Qty.	Location
1	T12 to 4ft RW T8 Sys \$12	1,673	Bldg A-D Light Logger ave
2	4-Foot T12 Delamp \$13	3	Bldg A Light Logger data
3	T8 to RW T8 Sys Retro \$8.5	64	Bldg A Light Logger data
4	T8 to RW T8 Sys Retro \$8.5	6	Bldg B Light Logger data
5	T8 to RW T8 Sys Retro \$8.5	536	Bldg D Light Logger data
6	4-Foot T12 Delamp \$13	14	Bldg A Light Logger data
7	T8/T5 Lamp w/EB 3-ft \$6	8	Bldg A Light Logger data
8	T8/T5 Lamp w/EB 3-ft \$6	8	Bldg D Light Logger data
9	OccSens:Wallbox-\$40	67	Bldg A-D Light Logger ave
Total		2,379	

Primary Business Descriptions: Site #12 consists of office space.

Variability in Schedule and Production: Discussions were held with personnel at the building to determine pre-existing lighting hours of use. Lighting loggers were installed at representative locations in the facility to determine ex post operational hours. These hours are reflected in the lighting surveys for the pre-installation and as-built conditions for each building.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

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$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V on-site audits for site #12 are provided in **Table 3**.

Table 3. Findings of the EM&V On-Site Audits for Site #12

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
		T12'S & SENSORS								
A - Hallway	12	1 Lamp F40 T12 4' 34 Watt	48	Remove 1 4' Lamp & - F032T8 28W Lamp Low Power Ballast	12	22	6112	6112	0.31	1,907
D-1 - Hall	11	1 Lamp F40 T12 4' 34 Watt	48	Remove 1 4' Lamp & F032T8 28W 841 Lamp Low Power Ballast	11	22	6007	6007	0.29	1,718
D-1 - Conf Rm	3	1 Lamp T5HO 54 Watt	60	Motion Sensor Wall Switch - 2 Pole	3	60	6007	5407	0.02	108
A-1 - Executive 1	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Executive 10	2	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	2	72	6112	5512	0.01	86
A-1 - Executive 2	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Executive 3	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Executive 4	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Executive 5	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Executive 6	5	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	5	72	6112	5512	0.04	216
A-1 - Executive 7	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Executive 8	2	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	2	72	6112	5512	0.01	86
A-1 - Executive 9	8	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	8	72	6112	5512	0.06	346
A-1 - Ext Rel 1	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Ext Rel 2	2	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	2	72	6112	5512	0.01	86
A-1 - Ext Rel 3	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Ext Rel 4	2	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	2	72	6112	5512	0.01	86
A-1 - Ext Rel 5	2	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	2	72	6112	5512	0.01	86
A-1 - Ext Rel 6	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Ext Rel 7	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - Ext Rel 8	4	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	4	72	6112	5512	0.03	173
A-1 - Ext Rel 9	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 10	4	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	4	72	6112	5512	0.03	173
A-1 - HR Rm 11	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 12	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 13	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 2	5	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	5	72	6112	5512	0.04	216
A-1 - HR Rm 3	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 4	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 5	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 6	4	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	4	72	6112	5512	0.03	173
A-1 - HR Rm 7	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 8	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-1 - HR Rm 9	3	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	3	72	6112	5512	0.02	130
A-2 - Training 2,3	48	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	48	72	6112	6112	0.00	0
B - 115	4	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	4	72	2749	2149	0.06	173
B - Conf Break	8	2 Lamp CFL-U 40 Watt	72	Motion Sensor Wall Switch - 2 Pole	8	72	2749	2149	0.13	346
D-1 - Men/Women Rest Room	4	2 Lamp F30 T12 3' 30 Watt	73	Remove 2 - 3' Lamp & 2 - F025T8 850 Lamps & Low Power Ballast	4	38	5407	5407	0.14	757
A - Men/Women Rest Room	8	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 850 Lamps Low Power Ballast	8	43	6112	6112	0.31	1,907
A-1 - 1018	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	5512	0.09	528
A-1 - Break Rm	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-1 - Break Rm Storage	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	5512	0.09	528
A-1 - Break Vending	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-1 - Conf Rm	4	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	4	43	6112	6112	0.16	953
A-1 - Elec	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-1 - Elec 2	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-1 - Halls	12	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	12	43	6112	6112	0.47	2,860
A-1 - Halls	40	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	40	43	6112	6112	1.56	9,535
A-1 - House K	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	1	43	6112	6112	0.04	238

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Table 3. Findings of the EM&V On-Site Audits for Site #12

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
A-1 - Kitch	6	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	6	43	6112	5512	0.26	1,585
A-1 - Tel 2	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-1 - Tel rm	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-1 - WH	6	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	6	43	6112	6112	0.23	1,430
A-1 - WH	103	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	103	43	6112	6112	4.02	24,552
A-1 - WH2	114	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	114	43	6112	6112	4.45	27,174
A-2 - Elec	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-2 - House K	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-2 - Mech	16	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	16	43	6112	6112	0.62	3,814
A-2 - Mech	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-2 - Stairs x 3	28	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	28	43	6112	6112	1.09	6,674
A-2 - Store	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-2 - Tel rm	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-B - 23	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	1	43	6112	5512	0.04	264
A-B - elec	8	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	8	43	6112	6112	0.31	1,907
A-B - Elec	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	1	43	6112	6112	0.04	238
A-B - Halls	17	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	17	43	6112	6112	0.66	4,052
A-B - House K	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	6112	0.08	477
A-B - Mom's	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	1	43	6112	6112	0.04	238
A-B - Rest MW	10	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	10	43	6112	6112	0.39	2,384
A-B - Storage 0103	10	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	10	43	6112	5512	0.43	2,642
A-B - Tel	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	1	43	6112	5512	0.04	264
A-B - Tel Equip 0021	18	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	18	43	6112	6112	0.70	4,291
A-B - UPS	10	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	10	43	6112	5512	0.43	2,642
A-B - WH 1	133	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	133	43	6112	6112	5.19	31,703
A-B - WH elv Equ Rm	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6112	5512	0.09	528
B - House K	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	1	43	2749	2749	0.04	107
B - MW rest	6	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	6	43	2749	2149	0.29	798
B - Outside Bath 2	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	1	43	2749	2749	0.04	107
B - Outside Breakroom #2	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 850 Lamps Low Power Ballast	1	43	2749	2749	0.04	107
B - Room 113	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 850 Lamps Low Power Ballast	1	43	2749	2749	0.04	107
B - Room 118	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 850 Lamps Low Power Ballast	1	43	2749	2749	0.04	107
B - Shop	13	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 850 Lamps Low Power Ballast	13	43	2749	2749	0.51	1,394
B - store rm	4	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	4	43	2749	2149	0.19	532
B - Tel rm.	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	2749	2749	0.08	214
B - WH	8	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	8	43	2749	2749	0.31	858

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Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
C - 112	4	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	4	43	2749	2749	0.16	429
C - 119	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	1	43	2749	2749	0.04	107
C - 121	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	1	43	2749	2149	0.05	133
C - Battery Room	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	1	43	2749	2749	0.04	107
C - Eve	5	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	5	43	2749	2749	0.20	536
C - M/W Bath	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	2	43	2749	2149	0.10	266
C - M/W Bathroom	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	2	43	2749	2149	0.10	266
C - Oil Room	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	2	43	2749	2749	0.08	214
C - Outside Telco	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	1	43	2749	2749	0.04	107
C - Shop	45	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	45	43	2749	2749	1.76	4,824
C - up	18	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	18	43	2749	2749	0.70	1,930
C - Wash Room	3	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	3	43	2749	2149	0.15	399
D-1 - East Hall	3	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 850 Lamps Low Power Ballast	3	43	6007	6007	0.12	703
D-1 - Elec rm	4	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	4	43	6007	6007	0.16	937
D-1 - elec rm 2	4	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	4	43	6007	6007	0.16	937
D-1 - House K	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	2	43	6007	6007	0.08	469
D-1 - House K 2	3	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	3	43	6007	6007	0.12	703
D-1 - Mech	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	2	43	6007	6007	0.08	469
D-1 - MW rest	8	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	8	43	6007	6007	0.31	1,874
D-1 - MW rest	8	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	8	43	6007	6007	0.31	1,874
D-1 - Stairs x 3	15	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 841 Lamps Low Power Ballast	15	43	6007	6007	0.59	3,514
D-2 - Electrical Room	4	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 850 Lamps Low Power Ballast	4	43	6007	6007	0.16	937
D-2 - Electrical Room #2	4	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 850 Lamps Low Power Ballast	4	43	6007	6007	0.16	937
D-2 - Housekeeping	2	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 850 Lamps Low Power Ballast	2	43	6007	6007	0.08	469
D-2 - Mechanical Room	1	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 850 Lamps Low Power Ballast	1	43	6007	6007	0.04	234
D-B - Electrical Room	4	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 850 Lamps Low Power Ballast	4	43	6007	6007	0.16	937
D-B - House Keeping	3	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 850 Lamps Low Power Ballast	3	43	6007	6007	0.12	703
D-B - Training Center	6	2 Lamp F40 T12 4' 34 Watt	82	Remove 2 - 4' Lamps 2 - F032T8 28W 850 Lamps Low Power Ballast	6	43	6007	6007	0.23	1,406
E - Boiler Room	15	2 Lamp F40 T12 4' 34w	82	Remove 2 - 4' lamps 2 - RW R032T8 28w 850 lamps & LBF ballast	15	43	6007	6007	0.59	3,514
E - High Voltage Room *	6	2 Lamp F40 T12 4' 34w	82	Remove 2 - 4' lamps 2 - RW R032T8 28w 850 lamps & LBF ballast	6	43	6007	6007	0.23	1,406
E - Room 122	2	2 Lamp F40 T12 4' 34w	82	Remove 2 - 4' lamps 2 - RW R032T8 28w 850 lamps & NBF ballast	2	43	6007	5407	0.09	520
E - Storage	6	2 Lamp F40 T12 4' 34w	82	Remove 2 - 4' lamps 2 - RW R032T8 28w 850 lamps & NBF ballast	6	43	6007	5407	0.26	1,560
D-2 - Freezer	3	2 Lamp F40 T12 HO 4'	145	NEW VAPOR TIGHT VPT-1X4-2L32T8s HBF Vapor tight	3	73	6007	5407	0.24	1,429
D-1 - Conf Rm	2	2 Lamp T5HO 54 Watt	117	Motion Sensor Wall Switch - 2 Pole	2	72	6007	5407	0.10	627
D-1 - Conf Rm	2	2 Lamp T5HO 54 Watt	117	Motion Sensor Wall Switch - 2 Pole	2	72	6007	5407	0.10	627
A-1 - Executive 11	1	3 Lamp CFL-U 40 Watt	105	Motion Sensor Wall Switch - 2 Pole	1	105	6112	5512	0.01	63
A-1 - Executive 12	1	3 Lamp CFL-U 40 Watt	105	Motion Sensor Wall Switch - 2 Pole	1	105	6112	5512	0.01	63
A-1 - HR Rm 1	1	3 Lamp CFL-U 40 Watt	105	Motion Sensor Wall Switch - 2 Pole	1	105	6112	5512	0.01	63
C - 101	5	3 Lamp F40 T12 4' 34	122	Remove 3 - 4' Lamps 2 - F032T8 841	5	43	2749	2149	0.44	1,215

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Table 3. Findings of the EM&V On-Site Audits for Site #12

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
		Watt		Low Power Ballast & White Reflector						
C - 103	3	3 Lamp F40 T12 4' 34 Watt	122	Remove 3 - 4' Lamps 2 - F032T8 841 Low Power Ballast & White Reflector	3	43	2749	2149	0.27	729
C - 122	4	3 Lamp F40 T12 4' 34 Watt	122	Remove 3 - 4' Lamps 2 - F032T8 841 Low Power Ballast & White Reflector	4	43	2749	2149	0.35	972
D-1 - Breakroom	3	3 Lamp F40 T12 4' 34 Watt	122	Remove 3 - 4' Lamps 2 - F032T8 841 Low Power Ballast & White Reflector	3	43	6007	6007	0.24	1,424
		T8's & Sensors								
A-2 - Halls	60	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	60	43	6112	6112	0.96	5,868
A-2 - Training	4	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	4	43	6112	6112	0.06	391
D-1 - Elec Rm	4	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	4	43	6007	6007	0.06	384
D-B - Cyber UPS	2	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6007	6007	0.03	192
D-B - Elev Rm	2	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6007	5407	0.04	244
D-B - Hall	4	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	4	43	6007	6007	0.06	384
D-B - MW rest	2	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6007	5407	0.04	244
D-B - Phone Rm	2	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	2	43	6007	5407	0.04	244
D-B - Staging	37	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	37	43	6007	6007	0.59	3,556
D-B - UPS	16	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Normal Power Ballast	16	48	6007	6007	0.18	1,057
D-B - Vault	4	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Low Power Ballast	4	43	6007	6007	0.06	384
D-B - WH	158	2 Lamp F32 T8 4'	59	Remove 2 - 4' Lamps 2 -F032T8 28W 841 Lamps Normal Power Ballast	158	48	6007	6007	1.74	10,440
D-1 - Break Rm	2	3 Lamp F32 T8 4'	88	Remove 3 - 4' Lamps 2 -F032T8 28W 841 NO Ballast White Reflector	2	48	6007	6007	0.08	481
B - Conf Rm	6	4 Lamp F32 T8 4'	112	Remove 4 - 4' Lamps 2 - F032T8 28W 841 HO Ballast White Reflector	6	65	2749	2149	0.37	1,009
		3' T12's						0		
A - Mens/Womens Rest Room	4	2 Lamp F30 T12 3' 30 Watt	73	Remove 2 - 3' Lamp 2 - F025T8 850 Lamps Low Power Ballast	4	38	6112	6112	0.14	856
D-2 - Mens/Womens Rest Room	4	2 Lamp F30 T12 3' 30 Watt	73	Remove 2 - 3' Lamp 2 - F025T8 850 Lamps Low Power Ballast	4	38	6007	6007	0.14	841
Total	1,329				1,329				39.69	219,523

Data Collection

Fixture Wattage and hours of operation are based on the Roseville Electric rebate application and on-site audit information collected at Site #12. Lighting logger data were collected for representative lighting fixtures at Site #12 as shown in **Table 4**.

Table 4. Lighting Logger Measurements for Site #12

Site Location	No Occupancy Sensor hours/yr	Occupancy Sensor hours/yr
Bldg A light logger data.log	6112	5512
Bldg B light logger data.log	2749	2149
Bldg D light logger data.log	6007	5407

Billing Data

Nine months of pre and post-retrofit utility billing data for Site #12 are provided in **Table 5**. The monthly average reduction in electricity demand is 79 kW and the monthly average reduction in electricity usage is 43,000 kWh. The extrapolated 12-month electricity reduction is approximately 516,000 kWh. This is significantly greater than the EM&V estimated lighting savings of 219,523

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kWh/yr. Lighting efficiency improvements represent approximately 50% of the average reduction in electricity demand and 42% of the average reduction in monthly electricity usage.

Table 5. Utility Billing Data Analysis for Site #12

Ex Ante Date	Billing Data Ex Ante kW	Billing Data Ex Ante kWh	Ex Post Date	Billing Data Ex Post kW	Billing Data Ex Post kWh	Billing Data Ex Post kW Difference	Billing Data Ex Post kWh Difference
4/14/10	910	505,000	4/14/11	940	412,000	-30	93,000
5/14/10	1,020	485,000	5/13/11	950	425,000	70	60,000
6/15/10	1,100	523,000	6/14/11	910	464,000	190	59,000
7/15/10	1,090	531,000	7/15/11	940	515,000	150	16,000
8/13/10	1,000	543,000	8/15/11	930	510,000	70	33,000
9/15/10	990	562,000	9/15/11	930	533,000	60	29,000
10/15/10	1,020	520,000	10/17/11	1,000	506,000	20	14,000
11/15/10	920	480,000	11/15/11	920	420,000	0	60,000
12/14/10	880	417,000	12/14/11	790	394,000	90	23,000
Average	1,019	507,333		940	464,333	79	43,000
Annualized						79	516,000
EM&V						39.69	219,523

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #12: (Retrofit Cost \$43,467 - Rebate \$28,224) / (Energy Savings \$24,148) = Simple Payback 0.61 Years.

Appendix D-13: Lighting Rebate Site #13

EM&V REPORT FOR LIGHTING SITE #13

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #13
Site Name: Site #13
Site Address: 10451 Fairway, Roseville, CA 95678
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Rennee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #13

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #13	n/a	Lighting	Roseville	Comm. Lighting	75,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			Rebate (\$)
		(kW)	(kWh/yr)	(therms)	
Site #13	Lighting	41.08	140,911	n/a	24,649

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			Cost (\$)
		(kW)	(kWh/yr)	(therms)	
Site #13	Lighting	40.54	180,390	n/a	86,301

Spillover

No evidence of spillover was found.

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #13. The Roseville Electric rebates are provided in Table 1. For 1 reported custom measure the total rebate was \$24,649. The custom lighting measure consists of 2,544 measures. The EM&V findings are based on installed fixtures including lamps and ballasts. The program tracks quantities of measures rather than fixtures.

Table 1. Planned Efficiency Improvements at Site #13

Measure	Description	Qty.	Location
1	Custom Lighting	1	Retail
Total		1	

Verified Efficiency Improvement: The EM&V findings are based on installed fixtures including lamps and ballasts. The study verified 2,544 installed measures (lamps installed and removed).

Table 2. Verified Efficiency Improvements at Site #13

Measure	Description	Qty.	Location
1	Custom Lighting	2,544	Retail
Total		2,544	

Primary Business Descriptions: Site #13 consists of office space.

Variability in Schedule and Production: Discussions were held with personnel at the building to determine pre-existing lighting hours of use. Lighting loggers were installed at representative locations in the facility to determine ex post operational hours. These hours are reflected in the lighting surveys for the pre-installation and as-built conditions for each building.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

Findings of the EM&V on-site audits for site #13 are provided in **Table 3**.

Table 3. Findings of the EM&V On-Site Audits for Site #13

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
Retail	1191	T8 F32 (2Lx4 ft)	99	T8 F28 (2Lx4 ft)	1194	65	4450	4450	40.30	179,331
Retail	49	T8 F32 (2L-Ux4 ft)	58	T8 F17 (2Lx2 ft)	62	42	4450	4450	0.24	1,059
Total	1240				1256				40.54	180,390

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Data Collection

On site EM&V inspections verified the number of fixtures and fixture wattage. Hours of operation are based on interviews with the building manager.

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #13: (Retrofit Cost \$86,301 - Rebate \$24,649) / (Energy Savings \$19,843) = Simple Payback 3.11 Years.

Appendix D-14: Lighting Rebate Site #14

EM&V REPORT FOR LIGHTING SITE #14

Prepared for Roseville Electric

Prepared by Robert Mowris & Associates

SITE SUMMARY INFORMATION

Company Name: Site #14
Site Name: Site #14
Site Address: 8875 Washington Blvd., Roseville, CA 95678
Principal Site Contact Name: N/A **Telephone:** N/A
Utility Representative Name: Rennee Laffey **Telephone:** (916) 774-5671
Assigned Lead Engineer: Robert Mowris, P.E., Ean Jones, B.S.

Site: Roseville Site #14

PROJECTS PAID BY PB FUNDS

Project	Account Number	End Use	Utility	Program	Sq. Ft.	Project Type
Site #14	n/a	Lighting	Roseville	Comm. Lighting	30,000	Rebate

MEASURES FOR EACH PROJECT

Item No.	Efficiency Measure	Ex Ante Savings Estimate			
		(kW)	(kWh/yr)	(therms)	Rebate (\$)
Site #14	Lighting	0.8	3,220	n/a	808

PROGRAM MEASUREMENT AND VERIFICATION SAVINGS ESTIMATE

Item No.	Efficiency Measure	EM&V Evaluation Gross Savings			
		(kW)	(kWh/yr)	(therms)	Cost (\$)
Site #14	Lighting	3.05	12,505	n/a	1,550

Spillover

No evidence of spillover was found.

Measure Description

Planned Efficiency Improvement: Based on information from the as-built specifications provided by Roseville Electric, the following efficiency improvements were planned under this project at Site #14. The Roseville Electric rebates are provided in Table 1. For 1 reported custom measure the total rebate was \$808. The custom lighting measure consists of 20 measures. The EM&V findings are based on the rebate application.

Table 1. Planned Efficiency Improvements at Site #14

Measure	Description	Qty.	Location
1	OccSens:Wallbox-\$40	18	Office
2	OccSens:Wall/Ceiling-\$44	2	Office
Total		20	

Verified Efficiency Improvement: According to the rebate application, the following energy efficiency improvements were installed at Site #14.

Table 2. Verified Efficiency Improvements at Site #14

Measure	Description	Qty.	Location
1	OccSens:Wallbox-\$40	378	Office
2	OccSens:Wall/Ceiling-\$44	42	Office
Total		420	

Primary Business Descriptions: Site #14 consists of office space.

Variability in Schedule and Production: The EM&V study evaluated the rebate application information to determine pre-existing and ex-post lighting operational hours.

Algorithms for Estimating Energy Savings for Paid Measure

Algorithms for estimating kW and kWh savings for each measure are based on pre-installation fixture wattages and hours of operation (obtained from maintenance personnel). The following spreadsheets provide ex-ante kW and kWh savings for each building. The general equations for calculating kW and kWh savings are as follows.

$$\text{kW Savings} = (kW_{pre} - kW_{post}) \times \text{Number}_{\text{fixtures}}$$

$$\text{kWh Savings} = (kW_{pre} - kW_{post}) \times \text{hours/year} \times \text{Number}_{\text{fixtures}}$$

EM&V findings for site #14 are provided in **Table 3**.

Table 3. EM&V Findings for Site #14

Area Description	Existing Qty.	Existing Fixture	Existing Watt Fixture	New Fixture	EM&V Ex Post Qty.	Ex Post Watt Fixture	Existing Hrs/yr	EM&V Ex Post Hrs/yr	Ex Post kW Savings	Ex Post kWh/y Savings
Teleplan	180	T8 F32 (2Lx4 ft)	61	Wallbox Sensor (T8 F32 2Lx4 ft)	180	61	4100	3075	2.75	11,255
Teleplan	20	T8 F32 (2Lx4 ft)	61	Wall, Ceiling Sensor (T8 F32 2Lx4 ft)	20	61	4100	3075	0.31	1,251
Total	200				200				3.05	12,505

EM&V Report for 2011 Roseville Electric Commercial Lighting Programs

Data Collection

Fixture Wattage and hours of operation are based on the Roseville Electric rebate application.

Customer Cost/Benefit Analysis

Cost and Payback (based on 2011 Roseville Electric Rates of 0.11 \$/kWh.

- Site #14: (Retrofit Cost \$1,550 - Rebate \$808) / (Energy Savings \$1,376) = Simple Payback 0.54 Years.